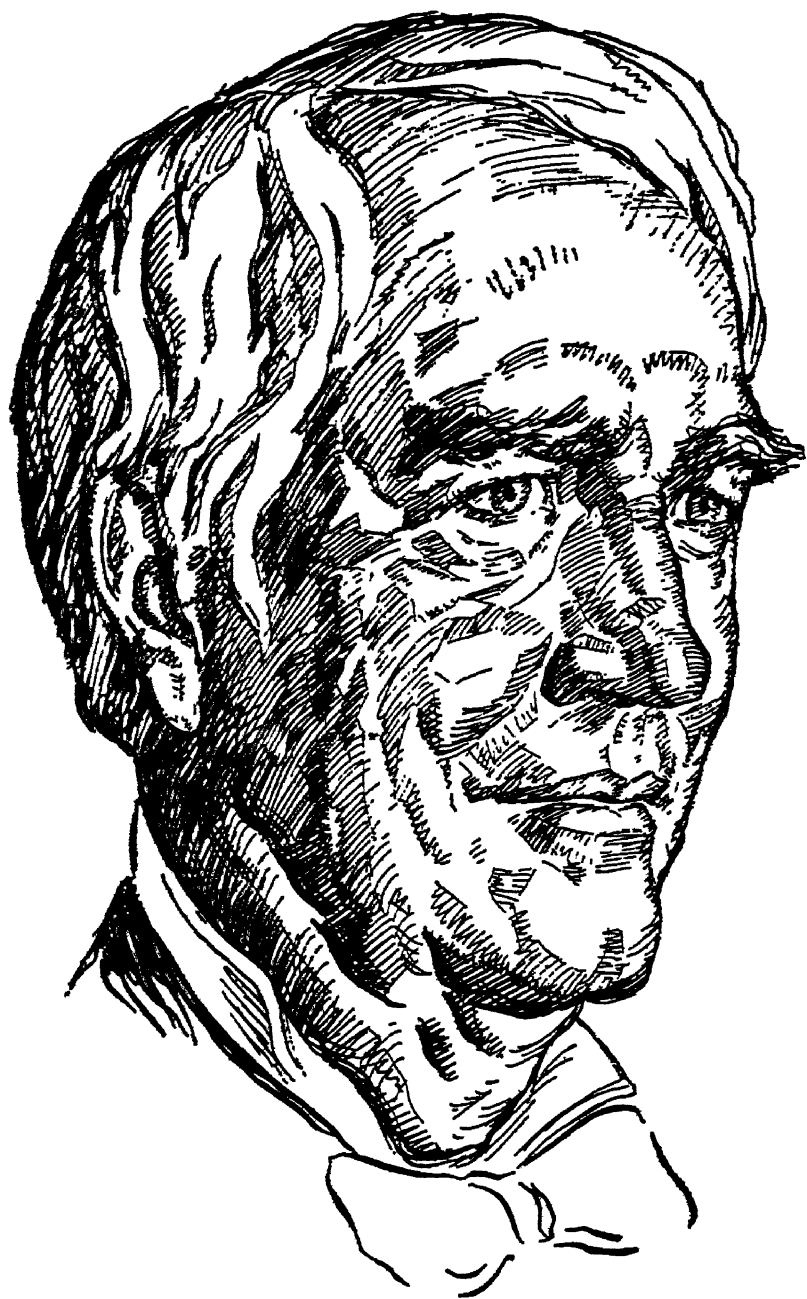


UNIVERSAL
LIBRARY



101 942

UNIVERSAL
LIBRARY



Thomas Alva
EDISON
BUILDER OF CIVILIZATION

BY H. GORDON GARBEDIAN

ILLUSTRATED BY ROBERT BURNS

JULIAN MESSNER, INC.

New York

PUBLISHED BY JULIAN MESSNER, INC.
8 WEST 40TH STREET, NEW YORK 18

COPYRIGHT, 1947,
By H. GORDON GARBEDIAN

Sixth Printing, 1960

MANUFACTURED IN THE UNITED STATES OF AMERICA
BY GEORGE MC KIBBIN & SON; BROOKLYN, NEW YORK

CONTENTS

1	A BOY MERCHANT	3
2	A BOY WITH A MAN'S DREAMS	8
3	HUSTLE WHILE YOU WAIT	20
4	THE DARKNESS BEFORE DAWN	30
5	TEA FOR TWO	45
6	A NURSLING OF IMMORTALITY	61
7	HOT MUSIC FROM COLD METAL	77
8	A TILLER IN GOD'S VINEYARD	94
9	BOTTLED SUNSHINE	111
10	THE ELECTRICAL AGE IS BORN	125
11	RIDING ON THE BACK OF ELECTRICITY	142
12	A NEW ROMANCE	159
13	FATHER OF THE MOTION PICTURE	179
14	BUILDER OF CIVILIZATION	191
15	AMERICA'S UNCROWNED KING	206
	HIGHLIGHTS IN THE LIFE OF THOMAS ALVA EDISON	225
	A SELECTED BIBLIOGRAPHY	228

•

THOMAS ALVA EDISON
Builder of Civilization

•

Chapter One

A BOY MERCHANT

A BOY, obviously in his early teens, appeared suddenly at one end of the train. He wore a white coat and on his head, at a jaunty angle over his right eye, a white cap. Shocks of unruly brown hair pushed out here and there from underneath the cap. The boy had his right arm hooked through the handle of a bountifully laden basket, which appeared to be too large and heavy for one of his years to manage. The train swayed sharply as it rounded a curve and he quickly clutched the basket with both hands to steady himself.

Having regained his balance, he toddled along the aisle. As he moved slowly along, he caused many of the passengers to smile as he called out at the top of his young voice, "Double-jointed peanuts, five cents for a large bag! Fresh popcorn, chewing gum, candy. Pears and apples. Havana cigars, just in from Kooba—three for only one nickel!"

The young "candy butcher" enjoyed a brisk trade. His Havana cigars, newly arrived from "Kooba," especially were in popular demand among the men. Some of them joked with the boy, as he made change, but none of them saw fit to correct his pronunciation of the Latin-American country. Perhaps, being farmers and business men who, for the most part, had a limited schooling themselves, they, too, did not know the difference.

A gray-haired, motherly looking lady who was sitting beside a window toward the rear of the coach turned her eyes from the endless variety of color and beauty into which Nature had

transformed the Michigan countryside. It was early November and Fall ruled the outdoors everywhere; the trees, preparing for their Winter's sleep, had robed themselves in a final burst of glory, in pink and red and burnished gold. Farmers were working late gathering in their last crops from orchards and from the chimney of a green and white farmhouse in the lee



of a gently-rounded hillside plumes of wood smoke curled toward the blue sky. She felt as if she could almost smell it!

But now she had a new interest. She watched the approaching boy with a faint smile. Something about him—his large gray-blue eyes and firm, square chin, his self-assurance, his unruffled good humor in the face of the teasing some of the men passengers were giving him—appealed to her. The candy butcher was curious about her, too. He had espied her shortly

after he had entered her coach. Here, obviously, was someone who was different from the farmers and small merchants, and their wives, who were the usual travelers on the trains between Detroit and Port Huron. Her clothes, if nothing more, set her aside—maybe she was from the East, even from New York, that faraway region about which an occasional traveling salesman had told him fabulous tales!

He responded eagerly to her beckoning smile. She purchased a pear and a bag of peanuts. He gave her an unusually large helping of the peanuts—it was the only way he knew of expressing his liking for her. He wanted to ask her whether she had come all the way from New York but couldn't quite get up his courage to do so, until she helped him.

"Aren't you rather young to be working on a train like this, young man?" she asked him. The kindness in her voice flattered, rather than irritated him as a similar question from another stranger might have done.

"No, ma'am. I'm thirteen years old, although you might not think so. Lots of boys of that age out this way earn their own living—and some girls not much older get married. I've been working a whole year already, and in a few more years I hope to have saved enough money to go to New York. Do you come from New York?"

"No, not quite," she replied with a laugh. "I suppose you mean the city of New York, the place all you young people talk and dream about. I live in Albany—that's in New York State but 150 miles up the Hudson River from New York City. I'm going to visit my son in New Baltimore. Is that far from here?"

"About an hour more. We stop there for thirty minutes. I'll be glad to come back and let you know when we are due."

"That's very nice of you. What is your name?"

"Thomas Alva Edison. My friends call me Tom."

"Well, Tom, perhaps you've heard of my son. He is the telegraph operator at the sta . . ."

"Not Jim Ridgeway?"

"Why, yes! You know him?"

"Do I know him!" There was a note of pride in the boy's voice, which did not escape the mother's ears, and the fire of their new friendship flamed with new strength. "He's the station master at New Baltimore. I speak to him every day. He promised to teach me how to be a telegraph operator some day."

"Have you known him long?"

"For about a year, since I started to work for the railroad."

"Are you and your family natives of this part of the country?"

"No, ma'am. My father is a fugitive from Canada."

"A fugitive! Is he a criminal?"

The question appealed to the boy's irrepressible sense of mischief and he decided to have a little fun.

"Well, you might call him that. He certainly would have been hanged and I would never have been born if they had caught him!"

But she had caught the gleam of mischief in his face and there was a twinkle in her eye, as well as curiosity in her voice, as she chided him.

"Well, you might as well tell me the details. Just what did he do? And why did they want to hang him?"

"Years ago, my father lived with my grandfather and the rest of his family in a place called Vienna in Canada. Someone gave the town enough money to build a two-room school and the daughter of the minister was appointed teacher. That's how my father got married. Because when he met the new school-teacher he fell in love with her. Shortly after they were married, my father went into business. He opened an

inn. Lots of people who came to his inn didn't like the government in Canada and my father was one of them."

"My goodness, but they don't hang people for not liking their government. If they did, many Americans . . .!"

"Oh, but my father decided to do something about it. He's always doing something about things he doesn't like."

"Young man, you sound as if you're speaking from deep conviction. I suppose there must've been many times when you've done things you shouldn't and your father has had to correct you."

"Well, ma'am, sometimes we do have differences of opinion. In fact, we have one of them now but I think I shall win this one when I get home."

"Well, I wouldn't be surprised," she said, remarking the boy's determined chin and the note of confidence in his voice. "But getting back to your father's escapade—just what did he do to make the rulers of Canada so mad that they wanted to hang him?"

"My father and many of his friends and neighbors thought the officials were a bunch of crooks and Tories who were making the people pay high taxes so that they could get rich more quickly. My father and the other discontented people used to meet in my father's inn to plan what to do. When it became dark, they got out their rifles and held drills in the yard back of the school."

"Why, that must have scared the daylights out of your mother. Why didn't she put a stop to your father's madness?"

"Oh, my mother's grandfather was an American and he fought against the British king in the War of the Revolution," the boy replied with exaltation in his voice. "She thought my father and the other rebels were doing the right thing in trying to correct the abuses of the government. But the trouble was some of the rebels got impatient and decided to capture

the government. But when the got into Toronto the government's army started firing on them and they all ran away."

"How did your father escape?"

"The soldiers searched everywhere for him but no one would tell where my father was. My grandfather had taught him some Indian trails through the backwoods when he was a boy and my father remembered them. So he walked 182 miles alone through the wilderness without any sleep until he came to the St. Clair River. This was in December and there was a lot of ice but my father wasn't sure whether the river was frozen deep enough. But he figured it was better to take a chance on drowning than to get caught and hang, so he walked on the ice and started for the American side."

"Well, it's a good thing he made it!"

"Yes, ma'am. I think so, too. My father always says that his long legs saved him!"

The train gave a shrill blast on its whistle and began to slow down. It was approaching a station. Tom Edison excused himself and dashed away. She saw him again a few minutes later from her window. He was hawking an armful of papers on the station platform to a group of eager buyers. His strident voice rose above the din of station noises.

"Here you are, the latest edition of the Detroit Free Press," he was crying. "Read all about the election of Abraham Lincoln. Five cents a copy."

The train gave a warning toot, toot! A moment later it slowly got into motion again. The candy butcher raced for the baggage car in the rear and swung himself aboard. His duties kept him busy for a while, but he was back in time to help her with her bags as the train pulled into the New Baltimore station.

"Be a good boy, Tom," she said in farewell. "Mind your

father. And be sure to drop in to see me again when you have the chance. I make very good fudge."

"Yes, ma'am. Thank you. I will."

As the train began the last lap of its sixty-three mile run from Detroit to Port Huron, his thoughts turned homeward. He would have an interesting story to tell his mother about his new friend. As for his father—they had been arguing for days and weeks now, and he thought he had at last found a plan to win that argument.

He was excited in anticipation of the effect his scheme might have on his father. The boy was waiting impatiently at the door of the baggage car as the church spire that was a landmark of the thriving town of Port Huron came into sight. The train began to lose speed. But Tom had no intention of waiting for the train to pull into the station today. As it passed a large sand bank, he jumped. Then he rose quickly, absently brushed the sand off his hands and trousers and raced across the fields towards home.

Chapter Two

A BOY WITH A MAN'S DREAMS

HOME to young Tom Edison was an impressive, solidly built Colonial house in the Fort Gratiot area on the northern outskirts of Port Huron. It was known as the "House in the Grove." It was so called because it stood amid a cluster of beautiful evergreen pine trees. To the rear of the house were extensive grounds. These included a fruit orchard of pear and apple trees and a vegetable garden of ten acres.

The interior as well as the exterior of the house gave evidence of good taste and of prosperity on the part of those who lived in it. The first floor consisted of a wide hall, flanked with large, high-ceilinged rooms with big fire-places. The second floor consisted of six comfortable bedrooms, whose large windows commanded a view of sweeping woodlands sloping to the banks of the St. Clair River, and of Lake Huron a mile away.

This panorama was so scenic that it had inspired Tom's father to build a tall tower, eighty feet high, in the rear of the house. From the platform of this tower an observer could watch the passing steamboats and lofty-sparred sailing ships that journeyed across the Great Lakes. Sightseers had to pay ten cents for this privilege. However, after the novelty of the tower had worn off, few visitors appeared. But for one person the beautiful and exciting panorama was always enthralling. Tom Edison never tired of it. The tower was one of his two favorite retreats. Whenever he could he would persuade his mother (who was an accomplice of his in creating the other

retreat in the cellar of the Edison home) to go with him to the windswept observatory.

When Samuel Edison, Tom's father, had run away from Canada in 1837 after the ill-fated rebellion against the government he had passed through Port Huron. He did not tarry long in the pretty town sprawling beside the river and lake front but the community made an indelible impression on him. He journeyed across northern Ohio along the southern shore of Lake Erie until he came to the then thriving town of Milan.

Milan recalled his boyhood home. Like Vienna, Milan was a bustling grain port. Its citizens had proudly nicknamed it the "Odessa of the West." It was the outlet for the produce of the extensive wheat lands of all northern Ohio and the rich Huron River valley. A canal linked the river with the lake and Milaners dreamed of the day when their city would be America's leading port.

Samuel Edison liked the promise the bustling town held out. He decided to cast his lot with it. He set up a small mill on the bank of the canal and started to manufacture shingles. Then, as soon as he had enough money, he sent for his wife, Nancy, and their two children. Two years after his flight from Canada the Edison family was reunited in a small red brick cottage perched atop a bluff overlooking the canal. It was in this cottage on a snowbound day that a new son was welcomed into the Edison household on February 11, 1847. The happy parents named the newcomer Thomas Alva—Thomas in honor of his uncle and Alva in gratitude to Alva Bradley, the lake captain who had brought Nancy Edison and her children from Vienna to Milan.

One day, a few months after Tom Edison's seventh birthday, his father came home for dinner in a brown study. Nancy Edison noticed her husband's preoccupied air and asked

anxiously, "Is something wrong, Sam? Was business bad today?"

"No, not especially," the head of the household replied, answering her second question first. "Not any worse than it has been recently or will be a year from now in this place."

"You mean because of the railroads?"

"Yes, that's exactly what I do mean. As you know, Milan has been losing a lot of the trade it used to have to the trains. And I just heard today that the railroad people are going to build a new line along the lake. I think that would kill most of the business that's left here. Nancy, I believe we ought to move out of here before the situation gets worse."

"But where could we go, Sam?"

"Oh, someplace with a future rather than with a past—someplace where the children could grow up with something to look forward to. When I first came to the States from Canada I saw a village on Lake Huron that I thought was mighty nice."

"What was it called?"

"Port Huron. It's a small place, but the country around it is very beautiful and I am sure you and the children would like it. I think I will go up that way Sunday and take a look around."

Sam Edison was full of good news upon his return from his inspection trip.

"Nancy, I've found a good grain and feed business that I can buy in Port Huron, and a big house for you and the children. If you have no objection, I think we ought to move up that way."

"I hate to leave our pretty cottage nere, Sam. But if you think that's the wise thing to do, why let's do it."

Her husband came over and pinched her arm fondly. The

years had enhanced rather than diminished their romance and he knew that he had won a prize that was his greatest possession in the matrimonial gamble.

"I knew you would say that, Nancy. That's why I have already bought the business and the house."

"You bought a house for me without even letting me see it! Why, Samuel Edison, if I don't like it you can sell it right back again!"

But she did like it. The move from Milan to Port Huron turned out to be a very fortunate one. As Samuel Edison had prophesied, Milan's prosperity, dependent on water traffic, declined rapidly with the invasion of the new railroad. His new business in Port Huron, on the other hand, prospered. Within a few years of his location in that lakeside town, he was recognized as one of its leading citizens.

Young Tom was enchanted with his new surroundings. He loved to roam the woods and along the shores of the lake, stuffing his pockets with strange creatures and odd-looking plants that interested him. He would bring these home and put them in bottles and jars which he kept on shelves in a nook of the big cellar.

"Thomas Alva," his mother called peremptorily the first time she chanced on the untidy collection.

"Yes, mother," there was a note of fear and entreaty in his voice. He knew his mother was seriously annoyed with him whenever she addressed him formally with his first and middle names. "Here I am!"

"What's this junk you have here?"

"They're a few things I picked up in the woods and places. I'm experimenting with them."

"Indeed, you are not. Get rid of the terrible mess this instant."

The boy broke into tears. "But, mother," he said, "I had a

great deal of trouble in getting them. They're not doing any harm to anyone."

"Your father will be angry, and will make a bonfire of the trash if he finds out what you've got here," she insisted, but in a milder tone. "Besides the other children might start fussing with them, too, and then I don't know what might happen."

"But, mother," he entreated, "look, I've got all the bottles marked." And he showed her a label plainly marked, "POISON," which he had attached to each bottle. "That'll keep them away."

"Humph! I doubt it."

As the boy began to cry again, his mother relented completely.

"Look, Tom, I'm going to let you keep this rubbish on one condition. You must move everything to that cupboard in the corner and I shall give you a key so that you may keep it locked. If you'll promise to do that, and to keep the cupboard tidy at all times, we'll keep this a secret between ourselves. Is it a bargain?"

"Oh, yes, mother, and thank you!"

Ever since he had been old enough to walk and talk Tom had shown ways of thinking and doing things that set him apart from other boys. His lively imagination and boundless curiosity led him to ask endless questions, as if he meant to strip his parents and his friends of all the knowledge they possessed. These qualities sometimes irritated his father, who would call him "the nervous little question box." But they won the sympathy of his mother and the ties of affection between the former schoolteacher and her son grew stronger with the years.

Tom not only had original ideas but he also insisted on testing them. He almost drowned in the canal in Milan one

day when he fell into the water while making his own personal investigation into the work of a shipyard. He was then four years old. Less serious but more amusing was his escapade with a mother goose.

"Since I am bigger," the boy reasoned to himself, "I should be able to hatch these eggs much more quickly."

So he chased the irate goose off her nest and sat down on the eggs himself. No geese hatched. Instead, the eggs broke, as his father had warned him they would.

Watching the birds against the blue sky, Tom wondered, as so many had wondered about the same phenomenon before him: Why could the birds move through the air? He put the question to his harassed father.

"Father, what makes the birds fly?"

"Why, I don't know son."

"Well, if a robin can fly, why can't I fly?"

"Because a robin has wings and you haven't."

"Why haven't I got wings?"

"I don't know."

"Why *don't* you know, father?"

Tom thought the matter over. The secret of flight he concluded, was simple. Birds were able to fly because they ate worms.

He owned some worms. He mashed these worms into water and took the fearful concoction to the hired girl.

"Sally, would you like to fly," he began innocently.

"Why, yes, master Tom, I guess I would," she smiled at him. "But flying is only for the birds, not for us humans."

"But I know how you can fly just as good as any bird. Here, all you have to do is drink this."

Sally took one look at the evil-looking mixture and firmly refused to touch it. But Tom persisted. To his entreaties he added the promise of his weekly allowance. The desperate

maid weakened. She swallowed a small dose and immediately collapsed onto the floor in anguish. Her cries brought Mrs. Edison, who summoned the doctor. The father punished the boy and then sent him to bed without his supper. But that did not discourage his passion for experimenting.

Tom entered the Port Huron Public School when the family moved to Michigan. That was his first and last experience with formal education. It lasted three months. The teacher had no sympathy with the dreamy boy who paid little heed to his books and to his instructor. He scolded the boy constantly and put him at the foot of the class. Then one day the mortified boy overheard the instructor report to the visiting inspector, "That Edison boy is addled. I don't think he'll ever amount to anything. He's not normal like other boys. It's a waste of time keeping him in school."

Tom ran home and between sobs related the incident to his mother. Nancy Edison lost no time. She whipped off her apron, fastened on her bonnet and with the seven-year-old boy holding her hand strode indignantly to the schoolhouse.

There the angry mother confronted the crestfallen instructor.

"So you think Tom is stupid, eh," she said. "You don't know what you're talking about. If you had half as much brains as he has, you'd be lucky and not so poor a teacher. Some day the world will hear of him but never of you."

It was mother love speaking rather than any firm conviction that the tearful boy standing beside her was destined for immortality. But her championship of him made Tom Edison vow that he would be worthy of his mother and prove to all the world that her confidence in him was not misplaced.

"My mother was the making of me," he was to recall in later life. "I was determined right then that I would not disappoint her. She was so true, so sure of me. I felt that I had

some one to live for. The memory of her was a constant blessing to me through the years."

Nancy Edison became a teacher again. But this time she had only one pupil—her own young son. The picture of the attractive, kindly mannered mother, wearing a plain black dress and a lace cap, reading to Tom on the front porch of their home became a familiar one to Port Huron's citizens. That picture was all the more striking because of the amazing



resemblance between the two. Tom had his mother's broad, smooth forehead, deep-set eyes, large, well-shaped head and plumpish cheeks. Both had a well-formed, full-lipped mouth with an amiable expression that lit up the whole face whenever it broke into one of its frequent smiles. Friends and neighbors never tired of remarking that the boy was "the very image of his mother."

Under his mother's guidance, Tom read, in the next four

years, such classics as Gibbon's "Decline and Fall of the Roman Empire," Hume's "History of England," Sear's "History of the World," Burton's "Anatomy of Melancholy" and the "Dictionary of Sciences." Sometimes Nancy Edison would read to Tom and sometimes the boy would read out loud while his mother listened and gave a helping hand whenever he encountered a particularly difficult passage.

The book that made the biggest impression on Tom was Parker's "School of Natural Philosophy." It was the first book on science that he had ever read. He was entranced with its contents, especially with the chapter dealing with wireless telegraphy. Morse had invented the wireless telegraph two years before the birth of Tom Edison and the new wonder had the same appeal to boys of the period as Superfortresses and tanks were to have to youngsters nearly a century later. Tom repeated many of the experiments outlined in Parker's volume in his meager underground laboratory. He yearned for the day when he would have enough money to install his own telegraph.

He saw the chance to realize that ambition when the ever-expanding railroads built a branch line running from Port Huron to Detroit.

"Mother," pleaded the twelve-year-old boy, "I want to work on the new railroad."

"Don't be silly, Tom," she replied firmly. "You are too young to be thinking of working."

Tom's father sided with his mother. Undaunted, the boy, his imagination afire with the opportunities he saw ahead, wrote to the railroad. He offered to work for nothing. All he asked was that he be allowed to sell newspapers, magazines and candy on the train and to keep whatever profits he might make. He was told he was too young.

Several weeks later a boy in a new uniform and a happy

grin boarded the morning train, with its orange and green and red passenger coaches, for the run from Port Huron to Detroit.

"Tom, please be very careful," were his mother's parting words as the train squealed out of the station.

Neither his parents nor the railroad officials had been able to withstand the boy's insistent pleas and arguments. They yielded to his persistence, as Nature, too, was to yield some of her most jealously guarded secrets to the same dogged persistence that simply would not take "no" for an answer!

Tom's train left each morning at seven o'clock and arrived in Detroit three hours later. On the return trip, it departed from Detroit at 6:30 P.M. and got back to Port Huron at 9:30 P.M. This gave Tom eight-and-a-half hours in the city, which then had a population of about 40,000 and offered countless sources of interest and amusement to a young boy from the country. He became a member of the Detroit Young Men's Society and spent a large part of his leisure hours in its library. There were 16,000 volumes on its shelves. Tom decided he would read them all, beginning with the first book on the first shelf! But he soon discovered that such indiscriminate reading was profitless and gave up his rash decision before the pressure of time and the demand of other interests.

Tom earned about two dollars a day from his work on the train. Each morning he gave his mother one dollar. He spent the rest of his earnings for books and for equipment for his cellar retreat and for a new laboratory he was creating in an unused corner of the baggage car of the train.

He invested some of his funds in building a homemade telegraph line between the Edison home and the dwelling of a chum, James Clancy, who lived about a half mile away. He strung stovepipe wire from tree to tree, about eight feet from the ground, between the two residences. He used rags and bottles for insulators and pieces of brass for keys. It was a

cumbersome, makeshift affair. But it worked! And the two boys happily clicked out and received the dot and dash messages of the Morse code while the other youngsters of the neighborhood envied them their good fortune.

There was a fly in their ointment, however. Each night Tom brought home some of his Detroit papers for his father to read. He would call his father's attention to particularly long and involved articles in the hope that his father would become so engrossed that he would forget about sending Tom to bed. But the ruse did not work. Punctually, each night, as the clock chimed eleven o'clock, the father would look up from his paper and call out, "Tom, it's your bedtime! Stop playing with that darn thing and hurry off to sleep. Remember you must get up early in the morning to make your train."

Tom thought over his father's "foolishness" in making him go to bed "so early" and thereby limiting his time for experimenting. He wondered what to do. He finally thought of a stratagem. He enlisted the aid of Jim Clancy and put his strategy to a test. It was this test that sent him home bursting with excitement on that memorable day when he met the nice lady from the mysterious East on the train.

"Tom, where are the papers tonight?" his father asked him that evening.

"Oh, father, I had only a few left and Jim Clancy took those for his folks."

Mr. Edison's face fell. "I was anxious to read the election news," he said. "But I guess I'll just have to miss it tonight."

"Er—father."

"Yes, son?"

"I think I can get the news for you from Jim—you know over our telegraph line."

Then the wily boy moved over eagerly to his instrument. He decoded the news dispatches that Jim Clancy sent from

the other end and handed them one by one to his father. It was after one o'clock before they were through.

This routine went on for three nights. But Samuel Edison was a shrewd man and quick to recognize shrewdness in others. On the fourth night he gave up.

"All right, Tom," conceded the one-time rebel with a smile, "you win. If you will bring the newspapers home with you from now on, you may stay up as late as you please."

Chapter Three

HUSTLE WHILE YOU WAIT

TOM EDISON sold about two hundred papers on an ordinary day. But the sharp-witted boy made an important discovery as the Civil War engulfed America and the tragic fratricidal conflict reached out to hit every community, and virtually every home, in the country. He noted that he could sell more papers, and sell them quicker and easier, whenever they contained news of an exciting war development, such as a big battle.

Tom arranged with a printer in the composing room of the Detroit Free Press to read the galley proofs of the important stories each day before the newspaper came off the presses. One day in the Spring of 1862 he walked into the composing room to find even the usually calm workmen in the grip of tense excitement. Wordlessly, a printer handed him a long galley proof, still wet with ink.

Tom read how rebel forces under Generals Johnston and Beauregard had surprised General Grant and his Union army at Shiloh Church on April 6. The Southerners had driven the men in blue back to within 600 yards of Pittsburgh Landing. Then, on the second day of the battle, a new Union Army of 25,000 men under General Buell reached the scene of the bloody struggle after forced marches. General Grant threw the reinforcements into the terrific fight in the nick of time to avert a major disaster. General Johnston was killed and each side lost more than 10,000 men. The two-day battle was one of the biggest of the Civil War and it marked a turning point in the war.

Tom read with mounting excitement. Then he dashed out of the newspaper office and to the railroad depot.

"Sam," he said to the telegraph operator there, "I will give you a copy of 'Harper's Weekly' free for the next six months if you will wire this message ahead to all the other operators along the line."

"Let me see the message, Tom." Sam read the three lines in a boyish scrawl that Tom had handed him. The message asked each operator to chalk on his bulletin board word of the great battle with the promise that full details about it would be available in the newspapers coming north on the evening train. "All right, Tom. I'll be glad to do it!"

Tom cried, "Thanks!" and turned to race back to the Detroit Free Press. There he confronted the circulation manager.

"I must have a thousand copies of the paper instead of two hundred," he told that surprised official.

"You must be crazy," was the retort. "Have you got enough money to pay for that many?"

"No, sir. I can pay for only three hundred copies now. But I promise to pay for the rest tomorrow."

"I'm sorry, my boy. You can have only as many papers as you have the cash to pay for."

Tom swallowed his disappointment and asked the way to the sanctum of Wilbur F. Storey, the editor. That dignitary, a tall, dark man, was puffing on a big cigar as he and a colleague scanned the latest bulletins from the battlefield. Tom could not wait. He marched right into the office without ceremony and spilled his story in breathless phrases. Mr. Storey was a kind-hearted man and he was taken with the boy's earnestness and initiative. He turned to his desk, scribbled a note and gave it to Tom with his best wishes.

"Give this boy all the papers he wants on credit," the note read. It was signed, "W. F. S.," the editor's initials.

Tom hired a boy to help him with the big bundles to the train. However, by that time anxiety was replacing some of his enthusiasm. If his scheme failed to work, he would be indebted to the Detroit Free Press for a large sum of money. He would not be able to repay it for many weeks.

The train's first stop was Utica. Tom usually sold two papers there. Today, on the strength of the battle news, he hoped to sell six. He sold forty. Eager crowds were waiting for the "news butcher" at each depot all along the line. Always a good business man, Tom raised his price from five to ten cents, and at the new price sold 150 copies at Mount Clemens. He had only a few papers left by the time the train reached Port Huron, hardly enough to meet the great demand. These he disposed of quickly at twenty-five cents each, carefully preserving one copy. This he presented to his father upon his arrival home. To his mother he turned over for safekeeping the small fortune of nearly a hundred dollars that he had netted through his enterprise.

A short time before this coup Tom, encouraged by his success in selling papers, had decided to become a newspaper editor and publisher himself! One day he cheerfully walked into a Detroit stationery store and pointed to a small hand press in one corner. The machine had been used by a Detroit hotel for printing menus. The hotel had gone bankrupt and the press had come into the store proprietor's possession as part payment on an overdue bill.

"How much do you want for that press?" Tom asked.

"One hundred dollars," was the reply.

"I'll give you fifty," Tom rejoined firmly. "It's been lying uselessly there for months, gathering dust. You know no one else will take it off your hands if I don't. Is it a deal?"

The owner attempted to bargain with him. The astute youngster turned and began to walk to the door.

"Young man, come back," the proprietor called after him. "This has been nothing but bad luck for me. You can have it for your price, but that's much less than what it's worth."

Tom installed the press in the same corner of the baggage car where he already maintained his "laboratory on wheels." With a bucketful of second-hand type that he bought from a printer in the Detroit Free Press, he was all set to become a newspaper publisher in his own right. The Scotch conductor of the train protested at first at the idea of a newspaper published on his train, but Tom persuaded him that it would be a good advertisement for the railroad. So the first issue of his Weekly Herald made its appearance.

Tom, now a gangly youth of fifteen, was his own editor, reporter, compositor, make-up man, copyreader, pressman, advertising manager and circulation manager. He boasted within a few months after the inauguration of the Weekly Herald that it had "the largest circulation of any newspaper in the world printed on a train." He might have added that it was the only one!

The newspaper consisted of a single sheet, the size of a lady's handkerchief. Tom printed items about happenings on the Detroit-Port Huron train and in the territory it served. Sometimes the telegraph operators along the run would take down late news reports from the telegraph and hand these to Tom when his train pulled in. The youthful editor would immediately put these items into type and print them as "hot news right off the wire." His spelling and punctuation were not always perfect. Thus, in a single issue, he referred to a commander of the Union forces as a "generl"; described a lost bag as a "valice"; called a thief who had run off with

a lady's purse a "villan" and reported that a train had been "delayid" by a heavy snowfall.

Tom sold single numbers of the paper for three cents. His rate to monthly subscribers, however, was eight cents per month. He had about 500 of these. In addition, he sold about 300 copies of the weekly to the passengers on his train. So his venture into newspaper publishing became a highly profitable one.

His readers learned of a new addition to the Little family in this item: "BIRTH—at Detroit Junction Refreshment Rooms on the 29th inst., the wife of A. Little of a daughter. It would be interesting to know if the lady is still living." In a column devoted to advertisements, one learned that "A very large business is done at M. V. Milords Waggon and Carriage shop, New Baltimore Station. All orders promptly attended to." And with an eye for his farmer readers, the young editor chronicled under "MARKETS" the report that butter was selling at twelve cents a pound and eggs at ten cents a dozen.

One day, as Tom went through the train selling his papers, with rather indifferent success, he suddenly found himself in the middle of an amusing adventure. He quickly turned it to his profit.

Upon entering the last car of the train he noticed two finely dressed young men traveling with a colored servant. The two dudes spotted the news butcher at the same time. They immediately beckoned him. Tom approached them with a degree of caution, however. For it was easy to see that the strangers were weary of their journey and were ready to snatch some fun wherever they might find it.

"Boy, what have you got there?" one of the dandies wanted to know.

"Detroit newspapers, sir. Would you like one?"

"Nicodemus," commanded the first speaker turning to the colored servant, "throw these papers out of the window."

The servant, dressed in bright colors that would have made him an ideal head usher for a movie palace, smilingly obeyed. Then, again obeying his master's orders, he opened a large iron-bound box beside him on the seat. He extracted a dollar and handed it to the surprised boy. Everyone laughed.

Tom returned to the baggage car and filled a basket with prize packages, candies and bags of peanuts. Again he made his way through the train, calling out his wares. When he reached the strange travelers, one of them grabbed the basket and threw it with all its contents out of the window.

"Nicodemus," he then ordered, "give the boy four dollars."

On his next trip, Tom loaded up with all the magazines and books he could carry. Much of it was stock that he had been unable to sell. These, too, disappeared out of the window, while all the passengers watched the performance with shrieks of laughter. Tom entered into the spirit of the occasion, and when he had seen all his merchandise spread over the Michigan landscape he went to the baggage car for his last possession. This was a large box, in which he kept his goods. He rolled it down the aisle of the train, toward the fun-loving young men. They did not disappoint him. The box, too, went off the train. Then one of the frolicsome strangers turned to Tom:

"Boy, have you anything more to sell?"

"No sir, you have thrown it all away."

"How much money did Nicodemus give you?"

"Twenty-seven dollars!"

"Nicodemus, throw the boy out of the window!"

Tom did not wait to find out if this order was in fun. He scampered out of the coach and raced for his sanctum in the baggage car. Everyone had a pleasant time, including Tom

who enjoyed his most profitable day since his sale of the *Battle of Shiloh* newspapers.

Tom's business kept on growing. Farmers would bring prized produce to his train and ask him to sell it for them in Detroit. Tom received a commission on all such sales. The number of travelers on the trains increased, as more and more settlers journeyed from the East to make their homes in the fertile lands of the mid-West. Tom found that business was taking up too much of his time. He no longer could find more than an occasional opportunity to spend in experimenting before the discolored bench of his "laboratory on wheels." He decided to hire some assistants. This decision led to tragedy. And that tragedy was to change Tom's life.

One of Tom's newsboys went through the train selling papers. Tom was in his corner of the baggage car, trying out a new chemical experiment he had been reading about. The train was going at high speed as it rounded a sharp curve. There was a sudden lurch. The baggage car trembled. Tom let out a startled cry. A stick of phosphorus fell to the floor, broke, and immediately burst into flames.

Tom stripped off his coat and began to fight the fire. In spite of his panic-stricken efforts, the flames spread. At this moment the conductor of the train, a dour, elderly Scot by the name of Alexander Stevenson, arrived to find out what the commotion was all about. He glared at Tom. Then he grabbed pails of water to extinguish the growing conflagration. When the fire was out, the conductor strode to Tom's workbench. He grabbed storage batteries, test tubes strange-looking bottles and, finally, Tom's printing press and threw them all out of the door. Then, still out of temper, he seized the young scientist and soundly boxed him on the ears.

"If you want to keep on working on my train, you may," he told Tom. "But hereafter there will be no more foolishness



Threw them all out of the door

with printing presses and experimenting. You will sell your candy and your papers to the passengers, as you're supposed to do, and nothing else. That's final!"

The broken-hearted boy retrieved what he could from the wreckage of his laboratory and took it home to his cellar retreat. But his father had heard of the accident on the train.

"Tom," he told his perplexing son, "I suppose it's useless to try to persuade you to give up this nonsense you call scientific research and to stick to business. But you must give up the cellar. Use the attic, if you must, for your so-called laboratory. We would rather have you over us than under us. Then if something goes wrong again you'll blow up only the top of the house!"

The boxing he had received from the train conductor affected Tom's hearing. It started what another tragic incident was to complete—his lifetime affliction of deafness.

Standing on the station platform at Smith's Creek selling his papers shortly after he had caused the fire on the train, Tom suddenly heard the train blow its whistle. It started to pull out of the station. Tom, his arms still full of papers, dashed for the nearest car. It happened to be the freight car. The baggage man, fearing that Tom might fall under the wheels, attempted to help him. He reached out and took hold of the boy's ears and lifted him up into the train. Tom felt something snap inside his head. From then on, his hearing was impaired. That deafness was to grow worse with the years, although Tom Edison took it philosophically as "a blessing."

"It keeps the noises of the world away and allows me to concentrate on the work in front of me," he often observed when friends attempted to commiserate for his deafness. "Perhaps that's why I can get along with so little sleep."

Another accident had a more fortunate ending. Tom stood chatting with his friend Jim Mackenzie, the station master

and telegraph operator at Mount Clemens, while his train took on water. Looking down the track, he was horrified to see little Jimmie, the station master's two and a half year old boy, step out on the gravelled track to pick up some bright object that had caught his eye. A freight train was heading for the child at considerable speed.

Tom did not hesitate. He dropped his papers and dashed down the track. He picked up the child in his arms and leaped to safety as the freight roared by.

Mackenzie was so overcome that he could only gasp out incoherent words of gratitude.

"Tom, you've saved the life of my boy, and I only wish I had the money to reward you," he said. "I haven't but I want to do something for you. It isn't much, but it's all I can do. I will make you as good a telegraph operator as I can and get you a job on the line."

Tom accepted the offer. Mackenzie found the boy an apt pupil who absorbed the Morse code "like a wet sponge." Tom made a set of telegraph instruments of his own to allow him to practice at home. Mackenzie was amazed with its perfection no less than he was with his pupil's progress.

"Tom," he said at the end of three months, "you know as much about telegraphy now as I do. There's nothing more I can teach you. You're ready to become a full-fledged telegraph operator whenever you want."

There was an opening for a railway operator on the "night wire" at Stratford Junction, in Canada, not far from Port Huron. Tom, now sixteen years old, was anxious to quit his work as a candy and news salesman on the train. The job of telegraph operator paid only twenty-five dollars a month, a fraction of what he had been earning. But money meant little to him. He wanted to grow, to get somewhere in the world. So he applied for the vacancy at Stratford Junction and on Mackenzie's recommendation obtained it.

Chapter Four

THE DARKNESS BEFORE DAWN

TOM EDISON's first invention did him no good. It got him fired!

When the sixteen-year-old youth reported for work at Stratford Junction in the early part of 1864 he was put in charge of the "Night wire." His hours of duty were from 7 P.M. to 7 A.M. He was supposed to sleep in the daytime. He did spend most of his daytime leisure in the room he had rented at a nearby boarding house. But not in bed. His mind was afire with visions and dreams. He spent the hours from his regular work in endless experimenting in the laboratory he had set up in one corner of his crowded bedroom.

This burning of the candle at both ends had one inevitable result. When Tom reported for work he was so tired and sleepy that he had to struggle to keep his eyes open. He frequently lost that struggle and fell into sound sleep at his desk.

One of the rules of the company was that each telegraph operator had to send once an hour the signal "A" to the office of the chief train dispatcher. In this way, the dispatcher was able to make certain that his operators were wide awake and on the job. When Tom's signal failed to come through on several occasions he was severely reprimanded.

"You will have to learn to keep awake on this job, young man," the dispatcher told him sternly. "Or else, you might as well pack your bags and leave right now!"

Tom took the scolding to heart. For several nights thereafter he was all that a wide-awake and alert telegraph operator should be. But nature began to reassert herself in no uncer-

tain terms. Tom had to make a choice. He could sleep in the daytime, or he could experiment. He could not do both. So he decided to keep on with his test tubes and electric batteries!

However, Tom's signal continued to come into the dispatcher's office on the dot once every hour. The signal always arrived punctually as the clock's big hand pointed to the hour. It was never a minute early or a minute late. This exactitude puzzled Hiram Morse, the chief dispatcher. One night, he had cause to call Tom shortly after Tom's signal had come in. But there was no response! He repeated the call. Still there was no answer. Now completely mystified and alarmed, Morse raced out of his office, clambered aboard a hand car and headed for Stratford Junction.

He arrived there shortly after midnight. His solitary journey through the dark had increased his alarm. He feared to find his young operator—for whom he had a warm personal affection—seriously injured, or perhaps even murdered! He rushed to the station and peered through the window. His anxiety gave way to bafflement, then to slowly mounting anger. There was Tom Edison, sleeping soundly in his chair, as if he didn't have a care in the world!

Morse walked quietly into the station. His brow was furrowed in deep thought. This was impossible! How could the boy be sleeping when his signal had been coming through regularly into the dispatcher's office?

Then he caught sight of a strange contraption on the desk near the telegraph instrument. It was an alarm clock which appeared to be hooked into the telegraph instrument. Could it be an alarm that was to wake Tom at the hour so that he could send his required signal? The hand of the clock was approaching the hour and the perplexed official decided to wait and watch what happened.

The clock slowly ticked away the passing minutes. Then

the hour hand reached one o'clock. But no alarm went off! Instead, there was a little whir. Attached to the clock was a revolving wheel with a notched rim. This device was connected with the telegraph circuit. The notched wheel opened the circuit when the clock struck the hour, while a lever flashed the letter "A" over the wire. Tom continued to sleep peacefully.

Morse leaned over and shook him vigorously. Tom rubbed the sleep out of his eyes. Then the dazed boy saw his angry superior before him. Tom needed only one look to learn his fate. Morse was obviously quite angry, but he could not altogether keep a note of admiration out of his voice.

"Tom, I trusted you and this is the way you return my confidence," he said. "This is an ingenious device, I must admit, but it isn't what the company is paying you for. Don't bother to take out a patent for it. You're fired! Let this be a lesson to you. Keep your mind on your work when you get another job and do your sleeping in bed."

Tom, in a penitent mood, promised Morse that he would follow this advice. He quickly obtained a new job as a telegraph operator in a nearby railroad depot. He began his duties with a firm resolve to keep his promise to Morse. However, he did not stay on his new job long enough to give that resolve a fair test.

A few nights after reporting for work, he received an order to hold a freight train. He replied immediately that he would. He rushed out to locate the signalman and to order him to set the stop signal. But before Tom could find him the freight train roared past the station. Tom knew that on the strength of his agreement to hold the freight, the dispatcher would permit another train to leave in the opposite direction on the single track line from the station below his.

Visions of a head-on collision filled Tom's mind. Panicky,

he began to run after the freight train, hoping to catch it at a near-by junction. In the darkness, he lost his footing and fell into a culvert. He was knocked senseless.

The two trains, meanwhile, continued to rush toward each other. Fortunately, the engineers at their cabin windows saw each other's headlight just in time. Frantically, they jammed on their brakes. A catastrophe was barely avoided by a few feet.

Tom Edison was summoned into the Toronto office of W. J. Spicer, the general manager of the railroad.

"Young man, this offense of yours is a most serious one," that official declared sternly. "Very severe loss of property and life might have resulted from your negligence. I think I shall make an example of you. I could send you to the penitentiary for five years and . . ."

Tom, trembling, broke in with an attempt to explain the situation. He knew he was not to blame for the near-accident. Spicer, a noted disciplinarian, feared everywhere for his uncompromising severity, listened coldly.

Just then, two distinguished English gentlemen walked into the general manager's office and Spicer rose to greet them. Tom sighed with relief. Then he slipped quietly out of the door. He did not stop until he found himself, at last, safe over the Canadian border, in his native land.

For the next four years, from 1864 to 1868, Tom Edison was a vagabond. He traveled from city to city, journeying as far south as New Orleans, as he searched for that niche for himself that he was not to find until after reaching New York. He obtained ten jobs—and was fired from five of them. The large, handsome head of the dreamy youth always was full of ideas—but his pockets and stomach were frequently empty.

Since the Civil War had called many of the nation's skilled telegraphers to the colors, even a relatively inexperienced youth

of seventeen was able to find work almost anywhere. Tom worked briefly at Lenawee Junction, Smith's Creek, Fort Wayne. He became more capable as he went along. His ramblings took him to Indianapolis in the Fall of 1864. Now eighteen years old, he was hired by the Western Union Telegraph Company at seventy-five dollars a month.

The ambitious youth wanted to do press reporting. That was the most difficult and the most highly paid work of a telegraph operator. But he was not yet fast enough to qualify for such an exacting test. His inventive ingenuity, however, was as wide awake as ever. A tape recorder printed the dots and dashes of the Morse code on a continuous strip of paper. Tom improvised a second register that took up the tape after it had passed through the first machine and then ran it off at a slower pace. He could keep up with that slower run. With the help of this arrangement, he was able to turn out accurate and clean press copy.

Everything went well until the night of President Lincoln's re-election. Election returns poured over the wires in a deluge. Tom could keep pace only by slowing down the second register to the point where he was actually an hour and a half behind the latest reports. The following day the newspapers complained of this tardiness. An investigation in the Western Union office led to the discovery of the duplicate register. Another Edison invention had to be discarded.

The wanderlust took Tom Edison to Detroit, Memphis, Nashville, Louisville. In the latter city, Tom Edison's career nearly had an abrupt and inglorious end.

He spent a large part of his earnings on books. These he devoured, as a hungry man might gobble a juicy steak. One night he attended an auction of secondhand books. Twenty unbound volumes of the *North American Review* were put up for sale.

"Two dollars!" cried out Tom Edison.

There was not another bid. Surprised and elated, Tom shouldered his bulky bundle and began to trudge homeward. Halfway to his boarding house, he felt a bullet whizz past his ear.

"Stop, thief!" A policeman was running after him, shouting at the top of his voice and brandishing a revolver.

"What have you got in that big bundle?" the officer said as he rushed up to the astonished youth.

"Books," was the quiet reply. Tom bent over and ripped open the package for the policeman's inspection.

"Books!" ejaculated the crestfallen officer in tones of deep disgust. "Why didn't you stop then when I called out to you?"

"I didn't hear you. You see, I am hard of hearing."

"Oh," murmured the policeman sympathetically. "It's lucky for you, boy, that I am such a bad shot. Otherwise, I might have killed you."

Then he bent over and divided Tom's heavy load into two bundles. He shouldered one of them.

"Come along," he said gruffly. "I'll help you with these books the rest of the way."

Tom lost his Louisville job when he spilled a bottle of sulphuric acid. He had been carrying on experiments in a vacant room of the telegraph office. The spilled acid ran through the floor and into the manager's office below, eating into his desk and fine carpet.

"This company wants operators, not experimenters," the manager brusquely informed Tom. "You can call for your pay at the cashier's window and get out."

Tom lost his next job when his superior, a General Coleman, found him spending much of his working hours making notes and drawings in a worn, leather notebook. Tom had been fired from his Lenawee Junction position because one

day, having an important message to send, he had cut in a busy line to send it. The operator he had interrupted happened to be the division superintendent. Since then Tom had been brooding over the fact that one could not send more than one message at a time over one wire. He felt that it should be possible to utilize a wire for at least two messages at a time. He was constantly hunting for a way to accomplish this. General Coleman, however, had no patience with such "foolishness."

"Any crazy fool ought to know that a wire can't be worked both ways at the same time," he told Tom, as he ordered him to take his "puttering" elsewhere.

Tom went back to Indianapolis, to Detroit, and then to Cincinnati. He arrived in the latter city hungry and penniless and without an overcoat in freezing weather. But by now he had made himself a highly skillful telegraph operator, one of the best in the business. He had no trouble in finding work in the Western Union office. He became staunch friends with another operator, a kindly, older man by the name of Milton Adams, who felt sorry for the lonesome youth and took an immediate liking to him. In the Spring of that year, Adams decided to head for Boston. He tried to persuade Tom to go with him. But Tom, seized with the wanderlust again, decided to move in another direction. He had been hearing fabulous stories about adventure and riches in South America. So with two other operators he headed for New Orleans to catch a ship for Latin-American ports.

When the "three Musketeers" arrived in New Orleans they discovered that their ship had already sailed. A Spanish seaman sought to dissuade the three youths from their trip.

"You had better stay right here in your own country," he counseled them. "All this talk about easy money in South America is a lot of rot."

Tom took the advice to heart. After five years of wandering like a rolling stone up and down the country his wanderlust was just about spent. His two companions, however, wanted to catch a ship about to sail for Mexico. They did. But when they arrived in Vera Cruz they were caught in a yellow fever epidemic. Both died.

Once again chance had saved Tom Edison from an untimely death. The youthful inventor, meanwhile, had turned northward. He wrote to his friend Milton Adams in Boston.

"Can you get me a job there?" he asked.

"Come along, whenever you like," Adams replied. "This is a wonderful city, with big opportunities for an ambitious fellow like you. I have spoken to Milliken, the boss in the office here, and he is willing to give you a trial."

When Tom Edison, now a young man of twenty-one, walked into the Boston office of Western Union there was an inaudible gasp and a titter among the staff. He had journeyed to Boston on a railroad pass which officials of the Grand Trunk, recalling his days as a newsboy on their trains, had obtained for him. It was Winter and his train had been snow-bound for three days in a blizzard on the way east. A disreputable looking linen duster was his only protective covering against the bitter cold. He wore a sadly begrimed hickory shirt, and a pair of badly shrunk jean breeches that were indifferently tucked into the tops of boots a size too large. The boots had been guiltless of blacking for months. On top of his hair, which had not been combed for a week, was a broad-brimmed butternut hat, a relic of his days in Memphis. The hat was torn and Tom's right ear pushed through the jagged opening.

"I want to see Mr. G. F. Milliken, the boss," this unprepossessing looking stranger confidently announced. "Where can I find him?"

"Over in that corner," answered a snickering office boy, pointing.

With the whole staff watching him slyly, Tom walked over to speak to Milliken. The "boss" was used to seeing all sorts of funny people turn up as telegraph operators. But this seedy looking tramp was in a class by himself, he told himself as he



stroked his long beard reflectively. Could this unkempt hayseed be the slick operator Adams had said he was? He doubted it.

"Come back at seven o'clock," he said finally, remembering that he had given his promise. "I told your friend Adams that we would give you a trial. We'll see when you come in tonight what you can do."

Promptly at seven, Tom installed himself behind a desk in the center of the office. There was a big bundle of blanks in front of him. He was to take a 1,000 word news report for the

Boston Globe from New York. The other men in the office grinned to themselves. They had utilized Tom's absence from the office to arrange to have the fastest operator in the New York office at the keys when Tom returned—if he did return.

Tom signaled that he was ready. His fingers flew over the pages, as the New York "ace" began sending, at first with medium speed, then faster and faster. Tom chanced to glance up and immediately noticed the smiling employees watching him. So this was a put-up job to haze him, he thought grimly. Well, he would show them!

He wrote for several hours without a pause. He did not miss a single word. When he thought the New York "speed king" had hit his maximum speed, he opened the key and did a little practical joking himself.

"Come, come, old man," he tapped. "Stop going to sleep. Pull yourself together and send with the other foot!"

Tom's astonished colleagues surrounded him the moment he had finished and thumped him on the back with friendly gusto. They recognized in this "scarecrow from Michigan" a first-class telegraph operator. They were glad and proud to have him as a co-worker. They took him to supper and insisted on paying for his meal.

Tom moved into the same hall bedroom with his friend Adams and the two became constant companions. He worked at the Western Union office at night. During the day he labored in a small workshop that he rented. He rarely slept more than four hours a day, spending the rest of his time at one workbench or the other.

One day, he found a complete set of Faraday's works in a secondhand bookshop and brought them home with him at four o'clock in the morning. His uncomplaining roommate went to sleep, while Tom opened the first volume and began devouring page after page. When Adams woke up, Tom was

still reading about the great scientist's electrical experiments.

"How about stopping for a while, Tom, and having some breakfast with me?" Adams asked anxiously.

Tom shook his head without lifting his eyes from the printed page in front of him.

"Milt," he said, "I have so much to do, and life is so short, that from now on I'm going to hustle!"

At the request of his friends in the office, Tom devised a contraption to kill the cockroaches in the office. Whenever the insects walked upon the ingeniously connected wires and completed the electrical circuit, they were instantly electrocuted. A Boston newspaper printed a half-column about Edison's method for ending the menace of cockroaches. Back in his workshop, Tom was busy with various inventions associated with the telegraph.

His friend Adams persuaded him to buy a new suit. It was not often that he indulged in such a luxury, so he decided to purchase a good one. He paid thirty dollars for a fine gray English tweed. He wore it the following Sunday when he went to his workshop to continue his experiments. Suddenly, a bottle of sulphuric acid exploded. The new garment was ruined!

"Oh, well," Tom commented philosophically. "That's what I get for spending so much money for a suit."

Meanwhile, his work as an inventor was growing both in scope and success. And contrary to his previous experience, he now had two friendly and sympathetic advisors—his constant companion, Milton Adams, and his chief in the Western Union office, Mr. Milliken. He built a double transmitter—the thing that "any damn fool knew was impossible," according to his employer in Memphis, General Coleman—and set to in order to make it commercially feasible. He invented an alphabetical dial instrument, which was to prove the fore-

runner of the dial system used today with modern telephones. Tom Edison's invention made it possible to spell out words in a central office and to transmit them at the same time to a similar dial in another place, where an office boy might put them together. He attempted to interest business men in his invention. But, unfortunately, he was a poor promoter. Everywhere the twenty-one year old youth went, he and his invention received the cold shoulder from the men with the capital to make the new device a commercial success.

Disappointed, but not discouraged, he returned to his tiny workshop. There a third invention was nearing perfection and he resumed work on it with keen expectations. It was in that workshop that his friend Adams found him one afternoon as he crashed breathlessly into the cellar laboratory.

"Oh, Tom," he cried, "have you forgotten your lecture date? We've got only ten minutes—and a mile to go to get to the school!"

"I'm sorry, Milt, it had completely slipped my mind," the crestfallen Tom replied. "Guess there isn't time enough to change or wash up, but a bunch of little boys shouldn't mind. Here, help me with this battery and instrument board. If we run, I guess we can still make it on time."

A fortnight previously, the principal of a "select school" had written to the Western Union and had requested that an expert be sent to lecture to her "children" on the intricacies of the telegraph at three o'clock on a Wednesday afternoon. In recognition of his growing reputation as an inventor, Tom received the assignment. He accepted the invitation to talk to "the kids" when he learned that he would receive a special fee for it and asked Adams to accompany him to illustrate the lecture.

Three o'clock was just chiming from a nearby church as the two unsuspecting young men, with a new coat of dirt on their

untidy garments but happy to be on time, raced panting into the school where the "kids" were expecting them.

Horror and amazement spread over unwashed Tom's face when he walked into the lecture hall. The "kids" turned out to be students of Boston's foremost academy for girls, all fashionably dressed. Tom's knees turned to rubber as he saw his elegant audience. For a moment or two, he could see the upturned faces before him only through a crimson maze, his tongue froze to the roof of his mouth and he thought he would faint. Then the courage of despair took hold of him. He plunged bravely into his subject. So thorough was his knowledge of it that he managed to present an interesting and lucid exposition of it, in spite of an occasional catching sensation at the back of his throat.

His diffident, modest manner apparently made a favorable impression. For whenever he met any of the pretty maidens in public following his lecture she invariably smiled upon him in greeting. Tom's associates in the Western Union office were deeply envious of his seemingly inexhaustible circle of fashionable lady friends. But Tom never forgot the embarrassment of his first lecture. He determined that his first lecture also would be his last.

On October 11, 1868, he filed an application for his first patent. It was for an invention that had been occupying all his leisure time for months. He was now satisfied that it was as perfect as he could make it. On June 1, 1869 he received his patent—No. 90,646—the first of hundreds that were to bear his name.

Patent No. 90,646 was for what Tom called "a vote recorder." His work as a press telegrapher had impressed him with the great confusion that seemed to pervade the halls of Congress whenever balloting on an important issue was taking place. His device was a very simple electrical instrument which

he believed would "purify" Congressional balloting. It made it possible for a Senator or Congressman to record his vote on any question merely by moving a switch on his desk, either to the right or to the left. Electric wires connected the switch with an instrument on the clerk's desk. When Senator Smith, for example, moved the switch it closed the circuit. The electric signal raced to the clerk's desk, where it made contact between the type spelling out the Senator's name and a chemically prepared paper on a roll ready to take the impression of the type. Thus, the indicator registered instantly the names of those who had voted. At the same time, it tabulated the "ayes" and "nays" against any measure.

Jubilantly, Tom hurried to Washington. He was confident that Congress would be glad to buy his invention for "at least \$50,000." He had to borrow \$100 to pay for the expenses of the trip. After much perseverance, Tom finally succeeded in obtaining permission to exhibit his invention before a Congressional committee.

The machine worked perfectly. The happy inventor began to weave rosy dreams of the future. Then suddenly his dream broke into a thousand pieces.

"Young man, your machine is everything you claimed for it," the chairman of the committee said. "It couldn't work better. But if there is one machine that we don't want down here, it is a vote recorder. That's the last thing on earth that we do want. Filibustering and delay often are the only weapons that a minority may have for defeating bad legislation. This is an excellent machine and you are a very ingenious young man. Now turn your attention to something more practical—and take this thing away!"

It was a crushing blow to Tom. All his savings had gone into perfecting the machine. Now no one wanted it! But he reacted in typical fashion.

"That will be a good lesson for me," the disappointed inventor told his friends upon his return to Boston. "I will never again waste time in inventing anything that is not wanted, that is not necessary and useful to the community at large."

Tom resolved to give up telegraphy and to devote all his time to inventing. His former boss, Milliken, advised him to leave Boston for New York.

"I have the utmost faith in you, Tom and I know you will make good," he said. "You are wasting your talents here. Go to New York where the opportunities are greater. I will give you a letter of introduction to the chief of our New York bureau and ask him to watch out for you."

Tom needed no persuasion. With Milliken's letter and his last fifty cents in his pocket, he boarded the night boat for New York—and immortality.

Chapter Five

TEA FOR TWO

THE pale, flickering gas lamps that dimly lighted the streets of New York in 1869 were being extinguished one by one as the first rays of dawn pinked the sky. Tom Edison watched from the bow of the Boston night boat with fascinated eyes as the spires of the city of his dreams emerged from the early morning mist. The vessel under him vibrated painfully as it nosed through Hell Gate and past the vividly painted ships from all parts of the world, loading and unloading strange cargoes alongside their piers on both sides of the East River. Finally, it bucked into its own wharf.

Tom walked down the gangplank in high glee. None of his fellow passengers, who chanced to throw a glance in the direction of the gangly, untidy, twenty-two year old youth, dreamed that here was a lad who was destined within a few years to become the toast of their bustling city. Tom was thrilled, at every turn, with his new surroundings. His enthusiasm was as boundless as his financial resources were limited.

He did not have a cent in his pockets. The journey from Boston had taken the last penny of his meager funds. Meanwhile, his breakfast-less stomach was complaining angrily. Unable to pay the fare for one of the horse-driven street cars that rattled by, he determined to shoulder his bag and walk the mile and a half to the Western Union office in Printing House Square. Once there, he hoped to enlist the sympathy of one of the telegraph operators so that he might borrow enough money to buy a meal.

As he trudged along, his keen eyes taking in one show-

window after another, he passed a warehouse. Workmen were unloading large bags of tea from Ceylon. A rotund merchant with a dimpled chin was tasting samples of the newly-arrived cargo. The aroma of the fragrant beverage brought Tom Edison to a dead stop. Hunger overcame diffidence.

"Would you be kind enough to let me have a cup of that tea?" he asked politely.

"Why, certainly, my boy," was the hearty reply. "Here, help yourself, and tell me what you think of it. This shipment just came in, and we want to be sure it's fit for a very select trade. What do you think of it?"

"I never tasted anything better in my life," Tom answered truthfully. "I am sure your customers will be pleased. Thank you and good-day."

"Well, good-bye, my boy. And good luck!"

When Tom entered the Western Union building, he discovered that Richard Hutchinson, the "speed king" who had been at the New York end of the wire on his first day in the Boston office, was in charge. Hutchinson slapped the visitor on the back and took him to lunch.

"Tom, I can arrange for you to sleep in the battery room of the Gold Indicator Company near here," Borst explained at the end of the meal. "It won't be very comfortable there in the cellar but neither will it cost you anything. If you're financially embarrassed at the moment, it might be a good idea to stay there until you get settled."

"That would suit me fine," Tom replied gratefully. "Er—I must confess I am a bit short of funds at the moment. In fact, I was going to ask you to lend me a dollar."

"Here it is. Now come along and I'll introduce you to the night man at the Gold Indicator so that he'll know it's all right for you to stay there."

The president of the Gold Indicator Company was S. S.

Laws, former president of the New York Stock Exchange. The concern operated small tickers which were installed in 300 brokers' offices. These tickers were connected with a single keyboard, in the head office, which transmitted the fluctuating market quotations of gold. The price of gold was a dominant factor in the commercial life of the city. Inflation and the general upheaval that followed the Civil War forced merchants to reprice their commodities daily, and sometimes several times a day, on the basis of the prevailing quotation for the rare metal.

Tom spent his first three days in New York sight-seeing and hunting for work. Much of his spare time went into a study of the complicated master-transmitter, with its manifold revolving wheels, in the office of the Gold Indicator Company. By dint of strict economy, he made his borrowed dollar last into the third day. Now, on his third New York afternoon he sat watching the operations of the machine. He had only a dime left in his pocket—barely enough to pay for apple dumplings and coffee for dinner. He was worried about the morrow and his lack of success in finding a job.

Suddenly, golden opportunity threw its doors wide open to the preoccupied stranger.

The transmitter abruptly halted. The flow of gold quotations to the Wall Street brokers ended without warning. Bedlam seized the headquarters of the Gold Indicator Company. Pandemonium grew worse by the minute as harassed messenger boys from 300 brokers' offices raced in, shouting that their tickers were out of order and their employers demanded instant action to repair them. Excited engineers appeared helpless to locate the trouble.

Tom stood up and walked over to the frantic president of the company.

"I think I know what the difficulty is, Mr. Laws," he said

calmly. "One of the contact springs broke. It has fallen down between two gear wheels."

"Fix it, for God's sake, fix it!" the tense Mr. Laws cried, turning to him. "And be quick about it!"

Tom Edison coolly removed the broken spring and reset the contact wheels at zero. Then he dispatched the entire force of helpers in the office to the various brokers' offices to



reset the individual tickers in consonance with the main instrument. Soon the whole system was operating as chirpily as ever.

Laws asked Tom into his office. He questioned him at length about his background, his knowledge of telegraphy, how he had learned so much about the gold ticker machine.

"How would you like to work for me?" he said finally.

"I've been trying for three days to persuade your foreman to hire me," Tom replied with a sheepish grin.

"From now on, you will be in charge of this plant," was the quick rejoinder. "The salary is \$300 a month."

Tom accepted the offer with quiet gravity. His new employer could hardly have guessed that the shy youth had nothing to eat since breakfast, that his knees were shaking so much with excitement that he feared he would fall on his face on his way out of Law's office. Then he rushed to "Smith and McNeill's" a restaurant famous throughout New York for its fine food, and celebrated with a gala dinner with all the trimmings.

An income of thirty-six hundred dollars a year was more money than Tom had ever had in his life. It made him feel rich. One of the first things he did with his new wealth was to open a workshop, similar to the one he had in Boston, where he could resume his laboratory experiments.

Meanwhile, Laws sold out his interest in the Gold Indicator Company to a rival company, the Gold and Stock Telegraph Company, of which General Marshall Lefferts was the president. So, Tom Edison found himself working for a new boss. However, he considered the stock ticker then in use an inferior instrument. He felt sure he could invent something better. He therefore resigned his position as office manager to devote his energies to the new invention he had in mind.

Within a few months, he had it. The Edison Universal Printer was much simpler and much more reliable than anything Wall Street had ever dreamed of. Essentially the same as the stock tickers in use throughout the country today, Edison's invention introduced the automatic unison stop. This insured synchronous operation of all the instruments in a system. A simple adjustment of the master transmitter was all that was necessary.

Tom demonstrated his new invention to General Lefferts.

Its simplicity, its great practical potentialities made the General enthusiastic.

"How much do you want for it?" he demanded.

Tom pondered a moment or two. Should he ask for \$5,000? He thought the Universal Printer was worth it. But perhaps \$3,000 would be more in line with what he might expect to receive. Then he had a flash of inspiration.

"Supposing you make me an offer, General," he said.

"All right. How would forty thousand dollars strike you?"

"I think that's fair enough," the stunned youth managed to stammer. He had all he could do to restrain whoops of delight.

"All right, then. I will have a contract drawn up. Come back in three days and we'll sign it and I'll give you your money."

Three days later, having signed the papers turning over his rights to the Universal Printer to General Lefferts, Tom received a slip of paper in payment. It was a check. He had never had one before and was dubious of its value. His skepticism became a firm conviction when he walked into a bank and handed the check to the paying teller. The teller glanced at the back of the check and then handed it back to Tom Edison.

"You will have to endorse this, young man," he said.

Because of his partial deafness, Tom failed to understand the teller. He thought he was being informed that the check was no good, a suspicion he himself had held right along. He broke out in a cold sweat. Then he seized the "slip of paper" and dashed back to General Lefferts. That gentleman burst into uproarious laughter when Tom blurted out his story.

"Why," he said, "the only matter with this check is that you must endorse it, you know sign it on the back, before being paid. That's what the teller must have told you but you

misunderstood. Here, I'll have my secretary go to the bank with you to make sure that there's no mixup this time."

Tom wanted the money in small bills. The teller thought that was a strange request but complied without comment. Tom emerged from the bank with every pocket bulging with the greenbacks that he had stuffed into it. He was happy, now that he actually had seen and felt his new wealth. But a new problem stared him in the face. He hurried home fearfully, expecting every policeman to take him into custody for robbing a bank, and upon reaching his lodging vaulted into his room and locked it. He sat up all night without sleep to guard his money.

Tom's common sense asserted itself the next morning. His pockets still stuffed to overflowing with money, he entered General Lefferts' office and asked him for advice. The General's mirth was more quiet and kindly this time. Again he summoned his secretary.

"Take Mr. Edison to the First National," he ordered. "Show him how to open a bank account. Especially," he added with a twinkle, "show him how he might withdraw his funds whenever he might wish."

Six months after his arrival in New York, so "broke" that he had to beg for a cup of tea for his first breakfast in the big city, Tom Edison found himself independently wealthy. The use he made of his money was characteristic. The amusements that would have attracted other young men of twenty-three did not appeal to him at all. He hunted through crowded lanes and dingy cobwebbed lofts until he found what he wanted on the top floor of a three story building in Newark. There, he opened his first full-fledged workshop. He invested his \$40,000 in machinery to equip it. General Lefferts gave him a large order for the manufacture of stock tickers and Tom Edison was forced to put on a day and night shift to turn out

the machines. He was his own foreman on both shifts, stealing a nap now and then in his chair in the office. He rarely slept more than four hours—the other twenty he devoted to work.

He wrote home to his parents in Port Huron, telling them that "you had better take it easy after this. Don't do any hard work and get mother anything she desires. You can draw on me for the money." He spoke of his wish to return that winter to Port Huron for a visit with his mother, who had become an invalid—a wish never to be fulfilled—and modestly concluded with a note on his spectacular success, "I have a large amount of business to attend to—I have one shop which employs 18 men and am fitting up another which will employ over 150 men—I am now what 'you' Democrats call a 'Bloated Eastern Manufacturer.'"

Money meant nothing to Tom Edison except a means to furthering his main objective—to create new inventions, to contrive new and better ways of doing the world's work. His enterprises grew in size and importance and in number. But there was no change in his mode of living. There was no break in his endless routine of work, and then some more work, to permit even the briefest of vacations. And he demanded the same sort of devotion to work from his men.

One day, he received a thirty-thousand-dollar order for his new stock printer. However, when the instrument was completed it would not perform properly. He chose a group of his best mechanics and locked them up in a room with himself.

"No one is going to leave this room until we get this machine to work right," he told them.

The men worked uncomplainingly, without proper food or sleep, for sixty hours. At the end of that time the machine was operating to Tom Edison's satisfaction. Only then did he unlock the door of the workshop.

"All right men, go home and get some sleep," he said. "Don't come back until you want."

The men were back on the job within twenty-four hours. They admired their earnest young employer. They had full confidence in his judgment and felt inspired by his leadership. But beyond their recognition of the unusual quality of their boss they had another incentive to work hard for him. He paid high wages and the best mechanics in the Newark area were eager to get on his staff.

For a long time the youthful inventor ran his factory without the aid of a bookkeeper. His books consisted of two hooks on the wall. He thrust the bills he owed on one hook and the accounts that were owed him on the other. If he had the money, he paid his bills when they fell due. Otherwise he gave a note for the money he owed. This system had obvious disadvantages. Consequently, he was constantly in hot water with his creditors and the banks.

"I can always hire some mathematician," he burst forth irritably when errors in his accounting were pointed out to him, "but they can't hire me!"

"Well, then, you better hire yourself a good one, or you won't have a business to look after," was the unsympathetic rejoinder of a banker.

When the confusion in his business affairs continued to grow worse, Tom Edison was persuaded by friends to heed the banker's advice. He hired a competent bookkeeper to keep his accounts in the orthodox business manner. The new bookkeeper spent a fortnight going through the collection of papers on the hooks and transcribing their data to his books. He then reported that Edison had made a profit of three thousand dollars. The inventor gave a party for his men to celebrate. A few days later, the bookkeeper approached Edison with a crestfallen air. He had found some new bills in a pigeon-

hole. These changed the profits to a loss of five hundred dollars. The inventor became depressed. But the bookkeeper continued to stumble upon new records tucked away in all sorts of unexpected places. He approached his superior once again.

"Mr. Edison," he said with a smile, "I think I have the last of your missing accounts, and now I find that you have been operating at a profit of seven thousand dollars."

"Whew!" the inventor exclaimed with relief. "That's much better than a loss of five hundred dollars. Hereafter, we'll keep our money in the bank and won't add up our profits until all our bills have been paid and the bank shows what we have left over."

The bookkeeper maintained a discreet silence. But he fervently hoped that "the boss" would stick to his resolution.

In the six years from 1870 to 1876, Tom Edison obtained patents for 122 separate inventions. Most of these dealt with various aspects of the art of telegraphy. The head of the Patent Office in Washington paid tribute to Edison's prodigious labors and publicly referred to him as "that young man in New Jersey who has made the path to the Patent Office hot with his footsteps."

The tremendous expansion of Morse's telegraph into one of the world's major communication systems was the result of the lush profusion of inventions that flowed from Edison's creative mind and boundless energy. During one particularly hectic period the inventor was busy with forty-five inventions at once! Most of these helped to reduce the cost of operation of the telegraph while increasing its speed and range. He put the final touches on his duplex scheme of telegraphic transmission and followed with the quadruplex and sextuplex telegraph systems.

If two trains were to run on a single track in opposite direc-

tions there could be only one result—catastrophe. But Tom Edison succeeded in achieving his dream of sending two messages in opposite directions at the same time over the same wire without any confusion or obstruction to each other. Then, in 1874, he improved his technique to send four messages over the same wire.

Water flowing through a set of pipes will fill the different pipes in exact proportion to their size. Tom Edison utilized the same principle in inventing his duplex telegraphy. By using electrical currents of varying strength and specially built rheostats and condensers to create varying degrees of resistance, or “pipes,” he was able to multiply the number of electrical messages that could be transmitted over one wire. The apparatus at each end of the wire was adapted to respond to one type of current and no other.

Tom Edison took his invention to the office of the president of the Western Union Telegraph Company, Dr. Norvin Green. Dr. Green did not believe that the schemes of so young an inventor could be worth anything. He dismissed Edison very quickly without a hearing.

The youthful genius could not be discouraged that easily. He knew the Western Union was the best company to handle his inventions. He kept knocking on Dr. Green’s door with a persistence that the corporation president found most annoying. Then, one day, Lady Luck, who had tapped Tom on his third day in New York in the office of the Gold Indicator Company, beckoned to him again. And the inventor responded with his usual alacrity.

Dr. Green was pacing his handsome, walnut-panelled office when Tom called. He was obviously in a very bad mood.

“So you’re here again,” he cried irascibly, seeing Tom. “I’ve told you a thousand times that we were not interested in your fool ideas!”

"But, Dr. Green, this invention of mine will save your company a great deal of money," the inventor pleaded. "If you will only let me show you how it works I'm sure . . ."

"Since you know all about telegraphy, young man," Dr. Green broke in with deep sarcasm, "perhaps you can tell us why our wires to Albany have stopped functioning suddenly."

Quick to see his opportunity, Tom snatched at the president's suggestion with an offer of his own.

"I will try to locate your trouble for you, Dr. Green," he said, "if you will promise to investigate my invention if I succeed."

"It's a bargain," Dr. Green retorted. It was plain that he was ready to promise anything to get rid of his incorrigible visitor.

"I might need two or three hours," Tom explained, overlooking the president's brusque manner.

"I will allow you two days," the latter replied less gruffly. The inventor's cool and confident manner carried an irresistible appeal that softened the edges of his ill temper. Perhaps the young fellow was not entirely crazy after all. Time would tell quickly enough!

Tom Edison hurried to the company's main office. His previous experience as a telegraph operator had made him many friends there. Everyone was eager to help him.

He called Pittsburgh. He then asked that the best man in that office be put on the wire. He instructed him to reach Albany and to direct an operator in that office to telegraph down the line toward New York as far as he could. Within an hour Tom Edison received the following reply from Pittsburgh, "Albany reports they can telegraph all right down to within two miles of Poughkeepsie and there is trouble with the wire there."

Tom took this message to Dr. Green. He explained quietly how he had obtained it.

"If you will send some men to Poughkeepsie with the materials to do the work, they will find a break in the wire that they can repair quickly enough," he pointed out.

Dr. Green followed Tom's instructions. The break was found and repaired the same afternoon. True to his word, Dr. Green invited Tom Edison to demonstrate his multiplex system of telegraphy before the company's board of directors. The test was an unqualified success. Upon Dr. Green's suggestion, the company bought Edison's duplex telegraphy system, and later it was to pay \$30,000 for his quadruplex system.

When Tom had gone, Dr. Green confessed ruefully to one of his colleagues, "It was my own stupidity that kept this invention from us for many months. I just couldn't believe that anyone so young, with such big ideas, could be anything but a crank!"

Meanwhile, other inventors were flocking to Tom Edison's laboratory with pleas that he aid them in taking the "bugs" out of machines they had contrived but could not make work properly. One of these was Sholes, who came from Milwaukee with the first crude model of a contraption under his arm which he called "the typewriter."

Tom Edison studied the machine. He found it to be a very rough approximation of what its creator had hoped to make it. The letters were not in alignment, so that a sentence on a piece of paper came out with numerous hills and valleys. The ribbons failed to distribute the ink properly and here and there characters, and whole words, failed to become impressed on the paper. However, the idea of a "typewriter" appealed to Tom Edison's vivid imagination.

"I'll see what I can do to make it work," he promised. "If

we succeed in building an efficient typewriter, it might someday revolutionize business practice."

When he began tinkering with it, the machine took more time to produce a letter than a business man needed to write it longhand. But within a few months he had created an efficient typewriter—the forerunner of the modern Remington—which was a real timesaver in handling business correspondence. The first typewriters were installed in the office of the Automatic Telegraph Company, whose president foresaw the day when all business letters would be written on typewriters. However, other business men were not equally farsighted. There was a deep prejudice against typewriters when they were first put on the market because many people considered it discourteous to send letters written on a machine instead of the more painstaking, and more personal, method by hand.

Slowly, but surely, the typewriter caught on. As its popularity increased, it created a whole new profession—that of stenography. Young women were welcomed in business offices for the first time and the whole of American industry and business began operating at a new tempo.

One of the young women who became a part of this new movement of "pioneers" obtained employment in Tom Edison's own laboratory. However, her business ability was not the main reason for her employment.

On a rainy afternoon, the youthful inventor ran down the stairs of his laboratory on his way to dinner. He came upon two schoolgirls in the doorway who had taken refuge there from the storm.

"I have an umbrella here, and I shall be glad to see that you girls reach home without getting wet," he volunteered.

The girls hesitated a moment. Then the younger one smiled prettily upon the inventor.

"Oh, thank you," she said. "That is very kind of you. We

don't have far to go and if you are sure we wouldn't be troubling you too much we will be delighted to accept your invitation."

Tom Edison learned that the two girls were sisters, Mary and Alice Stilwell. Both taught in a nearby Sunday school. The inventor, who had completely fallen under the spell of the younger sister's charm, became a frequent visitor to the school. His work, however, prevented him from seeing her as often as he wanted.

"Mary," the inventor said one day, several months after their first meeting, while escorting the girls home, "I am making some experiments with paper in my laboratory. I need some help. How would you like to come and work in the shop?"

"Why, I think that's a splendid idea," she replied in a soft voice. "I've been terribly bored since I graduated from school, with nothing to do at home. I've been feeling completely useless, as if I wasn't good for anything at all. I'm glad you think I'm good for something!"

"I am sure that you are," he replied, smiling down at her. Then they both broke into laughter in easy camaraderie.

Tom Edison's paper experiments were part of the work he was then doing in the effort to perfect the automatic telegraph. This device did not need an operator at the receiving end. Electric impulses guided the writing of a metallic pen on a chemically prepared paper. The inventor succeeded in increasing the speed of the machine so that it soon was able to send two hundred words a minute. But no known paper tape could move fast enough to keep up with that speed. He decided to invent a paper that would match his machine.

He ordered a pile of chemistry books from New York, London and Paris. The volumes, when placed one upon the other, made a stack five feet high. He studied them day and night.

He ate at his desk and slept in his chair for six weeks, hunting through hundreds of books for clues. As a result of his research, he prepared a volume of abstracts and formulas. Then he set Mary Stillwell and the rest of his staff to work on a long series of experiments. After 2,000 of these tests, he was able to produce a carbon solution that gave the world paraffin paper. This chemically coated, waxy paper did precisely what he wanted it to do—record more than two hundred words a minute on a wire two hundred and fifty miles long. He ultimately succeeded in recording thirty-one hundred words a minute.

Chapter Six

A NURSLING OF IMMORTALITY

TOM EDISON and Mary Stillwell were married in a simple ceremony in 1871, on a beautiful Christmas day. An eight-inch carpet of snow and the trees laced with fingers of brittle ice gave the countryside the appearance of a veritable fairyland. The twenty-four year old inventor had made up his mind to ask Mary to marry him many months earlier. But the first real tragedy in his life had caused him to postpone his proposal.

Nancy Edison died in April of that year, just as the trees in Port Huron were breaking out in Spring blossoms. She was sixty-one and her last years had been filled with much physical pain. The bonds that linked her and Tom remained as strong as ever throughout her life. Her patient invalidism was relieved with periods of great happiness when reports of her son's magnificent successes reached her. As for him, his mother's death hung like a pall over his existence. He felt her loss so keenly that he was unable to speak of her for years after her death, and then only to explain her goodness and how much of his own success he owed to her guidance and influence.

"The memory of her will always be a blessing to me," he would remark. "My mother was the making of me, and I have always tried to be worthy of her."

Meanwhile, the inventor's admiration for Mary Stillwell grew with their closer association in his laboratory. He was a frequent caller at her home and took her riding in a carriage across the rolling countryside whenever he could break away from the arduous duties he imposed upon himself in his work-

shop. She was an able and industrious young woman. Although friendship had been his primary motive in asking her to work for him, she soon proved herself a valuable assistant in his experiments that led to the invention of the paraffin paper. One day, during the latter part of those tests she looked up to find her employer at her shoulder.

She smiled up at him. He returned her smile. There was something in his manner that puzzled her. He seemed to lack the self-assurance and air of buoyant confidence that was so characteristic of him. He reminded her more of a nervous boy. There was a worried look on his usually cheerful round face and in his keen gray-blue eyes. He seemed at a loss for words. Suddenly, his mouth firmed, his shy uncertainty disappeared, as if he had made a mental resolution. He fished into his pocket for a silver coin. Then he began tapping out in Morse code a message that only she could hear and understand, "I have been thinking a great deal of you lately. Will you marry me?"

She laughed softly. Reaching across, she took the coin from his hand. She, too, tapped out in Morse code as she replied:

"That would make me very happy!"

After a brief honeymoon in Boston, the young inventor and his bride settled down in an eight-room residence at 97 Wright Street in Newark that he had bought and furnished. The bride's sister Alice came to live with them and to keep Mary Edison company. The hard-working inventor stayed away from his honeymoon home for a good part of each night. Sometimes he stayed away all night. But the bride never complained. She knew how wrapped up he was in his work and accepted her occasional loneliness as part of the price she had to pay for marrying a genius.

On February 18, 1873, about two and a half years after their marriage, their first child, a pretty girl who gave every

evidence of having inherited her parents' good looks, was born to the inventor and the former Mary Stillwell. They named her Marion Estelle, after Thomas Edison's oldest sister. Three years later, the inventor became a father again when his first son was born. The mother was firm in her insistence that their first boy receive the name of his already famous father, and the inventor finally agreed reluctantly to christening the boy Thomas Alva Edison, Jr., after himself.

The father liked nothing better than to spend his leisure hours out of his laboratory in the nursery with the two new additions to his household. He playfully nicknamed Marion "Dot" and Thomas, Jr., "Dash."

"Considering the stories you've told me of the hardships you endured as a telegraph operator I should think you'd want to forget about those days," his wife said in mock severity.

"Well, there's something simple and beautiful about the Morse code," the inventor replied with a sheepish grin to his wife's gentle chiding. Bending forward, he picked up the three-year-old Marion, lifted her high above his head and then gently set her on her feet again as she squealed with delight. "Just as," he added happily, "there is about our own Dot and Dash!"

When Marion was five and Tom, Jr., two years old, a new brother joined them. On October 26, 1878, Mary Stilwell Edison became a mother for the third and last time. Her third child was a robust boy weighing eight pounds, and she and the proud father agreed quickly this time to name him William. William—who was to grow up to play a heroic role in his country's tank corps in 1917 and 1918 during the first World War with Germany—was simply Bill to his father, who felt that Dot and Dash and Bill were the three finest children any parent had ever had!

"The children are well and thriving," the inventor wrote

in one of his letters to his father. "They sure are smart ones and no mistake!"

The inventor urged his father to visit them and to see his new grandchildren.

"Am now paying a man \$12 a week to care for the laboratory," Tom wrote his father. "You could live with me or any where else you pleased, and I will give you \$20 per week."

Samuel Edison, now past seventy, but still vigorous of mind and body and as independent of spirit as in the days when he turned rebel in his Canadian birthplace and had to escape across the border for his life, traveled to Newark to make the acquaintance of his daughter-in-law and her children.



Grandfather Edison arrived at a New York City pier, suitcase in hand, to board a ferryboat for Jersey City. The boat was just pulling away. Samuel Edison did not hesitate for a moment. Before the amazed guards could stop him, he ran back a few steps, then dashed to the edge of the pier and leaped across the more than ten feet of water to land safely

aboard the retreating ferryboat. It was a feat that ordinarily only a trained young athlete would have attempted. But Samuel Edison was surprised that other passengers on the ferryboat insisted on making what he called a "fuss" over him.

"Would you mind telling me your name, sir?" one persistent young man wanted to know.

"Samuel Edison."

"You are not related to the inventor in Newark by any chance, are you?"

"He is my son," was the proud reply. "I've just come East from Michigan to visit him."

"I hope you enjoy your visit," the young man said in parting. He helped to make that visit a memorable one, for he was a reporter for a morning New York newspaper. The next day thousands of New Yorkers read about the famous inventor's father and enjoyed a description of his unusual athletic prowess.

A few days after Samuel Edison's arrival in Newark, his son took him on a tour of inspection of his manufacturing plants. The old gentleman gaped in astonishment at the visible evidence of the giant strides his son had taken since his departure from Port Huron. But his son's future plans surprised him even more.

"Father, as you see, our workshop here has grown so big that it leaves little or no room for experimenting," Tom Edison said. "What I need is some quiet spot out in the country where I can build a fully equipped laboratory to carry on some research that I have long contemplated."

"Why, son," interjected Samuel Edison, "I thought you had already done all the inventing you had a mind to."

"No, father, I've just started. But I can't carry on my real work here. There are too many distractions. I wonder if you would look around for me and see if you can locate a suitable

spot for my laboratory. You can have a horse and wagon and go wherever you please."

Two weeks later, Samuel Edison told his son that he had found a place that he thought would meet the inventor's desires. Father and son went out together to inspect the site.

It was near a little railway station on the Pennsylvania Railroad between Elizabeth and Metuchen in Middlesex County, about twenty-five miles southwest of New York City. It was a secluded spot near an abandoned mine in a gently rolling section of the New Jersey meadows. Its name was Menlo Park—a name that Tom Edison was to make deathless.

"This is a very pretty place, father, the prettiest I've seen in New Jersey," the inventor said with admiration. "It's nice and quiet. Just what we need. We'll start building here right away."

Tom Edison built at Menlo Park his first large-scale laboratory. It was to be devoted exclusively to scientific research on the multitude of wonderful schemes that were constantly passing through his mind. The laboratory was constructed on the basis of the inventor's own plans, since there was no other structure like the one he wanted that architects might copy. It was a long, gray building, somewhat resembling a huge, rectangular box, with tall windows along the sides providing a large amount of natural light. The second of the two floors consisted of a single room lined with shelves. Within a short distance of the laboratory, the inventor built a handsome three-story residence for his family. The grounds contained a picturesque windmill, a flagpole, extensive gardens and a stable to one side of the well-kept lawn.

Tom Edison moved into his new laboratory in 1876, the same year in which the great Centennial Exposition in honor of the hundredth anniversary of the signing of the Declaration of Independence was held in Philadelphia. This was a won-

derful era in the life of the nation. The tremendous expansion of the railroads that followed the close of the Civil War had opened up the "wild and woolly west," and as the railroads doubled, and tripled, and quadrupled their pre-Civil War mileage the nation's industry and commerce received a great new impetus. The amazing changes and growth taking place in the country were reflected in the Centennial Exposition. Many wonderful and exciting exhibits were shown to the millions of thrilled Americans who traveled to the Philadelphia show. But even more fascinating miracles were about to emerge from Menlo Park. The telephone receiver, the phonograph, the electric light, the moving picture—these were to change the way of life of the whole world and to earn for their inventor the title of "the Wizard of Menlo Park."

Tom Edison's first invention in the Menlo Park laboratory was noteworthy chiefly because it was the first. It has long since been forgotten. The inventor called it the electric pen. The pen consisted of a round, black, sheath-like holder. At one end was a needle. This needle operated much like the needle in a sewing machine. It darted in and out when placed against a piece of paper, perforating the surface of the paper with a series of fine lines. The message thus inscribed could be run through a hand press to produce as many duplicates as might be desired. The electric pen eventually developed into the mimeograph machine of today for the multiplication of typewriting.

While the inventor was at his workbench one evening, he was surprised to see a strong spark jump from the core of a magnet. The sparks passed between carbon points at a distance from an interrupted current. Tom Edison had stumbled upon a strange and exciting phenomenon. He carefully wrote down in his notebook, "This is simply wonderful and a good proof that the cause of the spark is a new unknown force."

The whole world of science was as excited as the experimenters in Menlo Park with this discovery of a mysterious electrical force that had an inexplicable origin and had no respect for insulation or polarity. Edison christened it "the etheric force." Years later, this discovery became the foundation of wireless telegraphy. By utilizing the new power, the inventor succeeded in sending signals through gas pipes from his shop to his home. Edison became enthusiastic about its future possibilities. Indeed, he had in his hand the secret of wireless telegraphy and of radio. He might have gone on to become the first to give the world these two great inventions. But the announcement of a startling new invention—the telephone—diverted him to another field of investigation. For a quarter of a century a fascinating and startling idea had stimulated the imagination of the world. This was the possibility of employing electricity to send the human voice over great distances. It was first suggested by a French scientist, Charles Boursel, in 1852, in graphic and prophetic language.

"I have often asked myself if the spoken word itself could not be transmitted by electricity," the Frenchman wrote. "In a word, if what was spoken in Vienna could not be heard in Paris. Suppose that a man speaks near a movable disk, sufficiently flexible to lose none of the vibrations of the voice; that the disk alternately makes and breaks the connection with the battery, you might have at a distance another disk which will simultaneously execute the same vibrations."

For some strange reason, Boursel did not follow up his own brilliant idea. Perhaps he understood that he did not have the technical genius to make his dream a practical reality. His vision, however, set on fire the imagination of a German professor, Philip Reis of Frankfort. Reis succeeded in building a rudimentary telephone in 1860 with a receiver that was able to faintly reproduce sounds. The Reis receiver could not, how-

ever, reproduce the human voice. It was not an articulating transmitter only because of a simple failure by its inventor. If Reis had thought of turning one of the screws on his apparatus a fractional rotation on its axis and had connected two particular binding posts by a wire to make sure that the contacts would remain continuously in contact, he might have become the father of the telephone. He failed to achieve fame and fortune by a very narrow margin—perhaps the narrowest margin by which any inventor has failed to attain his life's dream.

Three great Americans then entered the race to be the first to give the world a new system of communication. They were a former "candy butcher" on a train, a Quaker carpenter and a teacher of elocution—Thomas Alva Edison, Elisha Gray and Alexander Graham Bell.

It was a very close race. Any of the three might have won it.

Edison attacked the problem of creating a practical telephone by first attempting to correct the faults in the Reis instrument. The German professor's mechanism would stay in adjustment only a few seconds at a time. Whenever a sound was transmitted through it, the vibration would break the circuit. Edison tried to avoid this break by placing a drop of water between the platinum point and the diaphragm. The inventor was disappointed to find that the water decomposed. He tried a new approach.

On January 14, 1876, Edison filed an application with the United States Patent Office. His caveat was a formal notification that he was working on "the first telephone" and had invented an instrument that would carry the human voice. It admitted, however, that the Edison telephone still was in an imperfect stage. It described the new instrument as consisting of two hollow metal cylinders. One cylinder was set inside the other like a telescopic tube. The metal end of the outer cylinder was equipped with two electromagnet coils and served as

a thin, vibrating disk, or diaphragm. When a person spoke into one cylinder, this crude device would transmit the human voice to the other cylinder.

It was while his telephone was in this rudimentary state that Edison stumbled upon the phenomena of his "etheric force." He was so fascinated by this amazing discovery that he temporarily put aside his experiments with the telephone. That decision may have cost him the honor of being the first to give the world a complete telephone.

Exactly a month after Edison had filed his caveat, on February 14, 1876, Alexander Graham Bell of Salem, Massachusetts, filed his application for a patent for his first telephone. Two hours after Bell had walked out of the Patent Office, Elisha Gray of Chicago walked in. Gray wanted a patent for an invention "transmitting vocal sounds through electrical propulsion." Both the Bell and Gray applications, by a strange coincidence, covered practically the same ground. Both included a complete model of the telephone capable of carrying the human voice.

The Edison caveat was deemed insufficient to hold his claims to the telephone. Bell won the race over Gray by the margin of two hours. On March 7, three weeks after filing his application, Bell received a patent recognizing his rights as the inventor of the first telephone. Overnight, he leaped to world fame. Bell lost no time. He organized the Bell Telephone Company and started to manufacture his telephone instruments.

However, the Bell telephone was far from perfect. It was a clumsy, pear-shaped device. It was both receiver and transmitter. It was placed at the lips for speech. Then it was put to the ear to catch the reply. Users of the telephone were warned, "Don't talk with your ear, nor listen with your mouth!"

In the beginning, the public looked upon the telephone as

an interesting curiosity. It was merely a scientific toy and no one could foresee that it would some day win a place as one of the most wonderful bits of mechanism ever created. Bell offered his invention to the Western Union Telegraph Company for \$100,000. The offer was scornfully rejected. Bell, discouraged and desperate in his need for money, offered to give a friend a half interest in his invention for \$2,500. He was unsuccessful. Then Bell asked an official in the Patent Office for \$100 in exchange for a tenth interest. But the unimaginative and cautious official also rejected Bell's offer. That refusal was to plague him for the rest of his life. For a decade later a tenth interest in Bell's invention was worth \$1,500,000!

In spite of its defects, Bell's telephone slowly won friends. Business firms began discarding their telegraphs and installing telephones instead. Then the Western Union Telegraph Company abruptly changed its mind about the value of Bell's invention. William Orton, president of the company, anxiously summoned Edison to his office.

"Mr. Edison, we must have a telephone," he said. "Do you think you could give us one?"

"I have been working on a new instrument that we think will be a great improvement over Bell's device," the inventor replied quietly. "I think there is a tremendous future for the telephone. At present, its usefulness is limited because it is so weak in reproducing the voice and picks up so much static. I think we can overcome those weaknesses if we can succeed in building a separate mouthpiece or transmitter. That's what we are working on now."

"We will pay you \$150 a week for the next five years for first claim on any telephone instruments or improvements you may succeed in making," the president offered.

"That's agreeable," the inventor replied cheerfully. "Send the agreement to my office and I will sign it."

The telephone instrument created by Bell was a simple device. He wound a coil of fine copper wire around the pole of a permanent bar magnet. Then he placed a soft iron disk in front of the pole and attached a mouthpiece to it. The receiver was made exactly the same way. When one spoke into the mouthpiece, the voice created sound waves. These struck the sending disk and made it vibrate. This vibration, in turn, caused the electrical current in the wire to vary. At the receiving end of the telephone, the disk vibrated in accordance with the electrical variations in the line. It therefore vibrated exactly as the sending disk vibrated when one spoke into it. Thus, the human voice changed into sound waves, then into electrical current, then back into sound waves. This simple principle made the telephone talk!

What Edison started out to do was to find the material that would best convert the human voice into electric impulses. He invaded a hitherto unexplored field of investigation. He tried water, sponges, moistened paper, felting, thin films of graphite. The results were disappointing. After each test, Edison's notebook contained the notation "N.G." or "N.B."—meaning "No Good" or "No Better."

Edison decided that he was on the wrong track. He dropped solids and took up fibers. The inventor's notebook now contained more encouraging notations—"L.B." or "E." The tests with fibers were a "little better" and "encouraging" in that the volume of sound was much greater than anything that had been possible previously. But the articulation lacked clarity. Weary months passed. Edison experimented with quicksilver, cork, black lead, mercury. He introduced the induction coil into the art of telephony. He invented fifty different kinds of telephones. Slowly but surely the voice emerging from his instrument grew in strength and in clearness. But Edison was still far from satisfied.

"I am working on the talking telephone and as yet it is not sufficiently perfect for introduction," he wrote to the president of the Western Union. "It is however more perfect than Bell's. You need have no alarm about Bell's monopoly as there are several things that he must discover before it will be at all practicable for every day use. When my apparatus is perfect you will be informed."

Edison was working late in his laboratory one night when a kerosene lamp burned out. A workman approached to remove the lamp and to replenish its fuel.

"Just a minute," the inventor suddenly called out. "Let me have that glass chimney."

The workman silently removed the glass, coated over on the inside with lampblack, and handed it to his intent employer. The inventor recalled that materials containing carbon had given the best results he had so far obtained in transmitting sound. As the workman watched him curiously, Edison eagerly scraped off some of the kerosene soot. At the very first test he broke out in broad smiles.

"V.E." read the notebook—"Very Encouraging."

The higher up in the glass chimney he scraped, the blacker became the lampblack—and the better the results. At the top of the chimney the lampblack was of perfect quality. In Edison's telephone it multiplied the volume tenfold and did it with perfect clarity. The carbon transmitter was born!

When the first tests with the original Bell telephone were made between New York and Newark, hardly a word could be heard. The first test of Edison's transmitter was over regular Western Union wires between New York and Philadelphia. It was a great success. Edison had taken the feeble voice left by Bell's original instrument and had given it almost unlimited power—a power to gird the earth with the human voice. An infant in swaddling clothes had suddenly become a giant.

"How much do you want for your transmitter?" Orton asked the inventor.

Edison thought that his invention was worth twenty-five thousand dollars. But he felt somewhat shaky and uncertain about asking for such a large sum.

"Why don't you make me an offer, Mr. Orton?" he therefore countered.

"How would \$100,000 suit you?"

"All right. It's yours, but on one condition."

"Well, perhaps we can meet the condition. What is it?"

"The condition is that you mustn't pay me the \$100,000 all at once. I want the money at the rate of \$6,000 a year during the life of the patent—for seventeen years."

"Why, of course, if you want it that way," Mr. Orton replied in a surprised voice. "But isn't that a rather curious arrangement?"

"Yes, I suppose it is. But I've learned that I can't trust my business capacity too far. If you were to pay me all at once, I would spend the \$100,000 on experiments and probably run into debt. But this way I will have to suit my ambitions to my pocketbook. That will save me a lot of worrying over financial matters."

Edison knew what he was talking about. For several new ideas had taken root in his mind and he was afire with the desire to start testing them in his laboratory. But he was to make another important contribution to the telephone before he was free to explore these new fields that his energies created in bewildering profusion.

A cablegram from Samuel Insull, representing the Edison interests in England, called for help.

"Bell representatives here threaten suit for infringement of their receiver," it read. "Can you help us?"

"Hold on," was the reply received the following day. "Will give you a new receiver in a few weeks."

Edison, who had invented a new telephone transmitter, now turned his attention to creating a new telephone receiver as well. This meant that he had to find a way to dispense with the magnet, which was the basis of the Bell receiver. Edison recalled that in his work with the telegraph he had been able to replace the electromagnet of the telegraph with a piece of chalk. He decided to utilize the same principle for the telephone receiver.

He created a small revolving cylinder of chalk, moistened with chemicals. He tried it in the telephone receiver and found that it was superior to the magnet in converting sound waves into electric waves, and the electric waves back into sound waves. Six receivers were quickly constructed and rushed to England.

"New telephone receiver highly satisfactory," was the London reaction. "Offer thirty thousand for it."

Edison immediately accepted, believing that the offer meant thirty thousand dollars. He was astonished and pleased to discover upon receiving the check that the English promoters had meant thirty thousand pounds!

Edison was responsible for still another invention in the art of telephony. When the first telephones came into use, people were accustomed to ring a bell on the box and then say, ponderously, "Are you there? Are you ready to talk?"

Edison picked up a telephone during the tests in his laboratory one day and yelled, "Hello!" That salutation caught on and became the universal language for the start of a telephone conversation the world over.

In the years that followed Edison's invention of the carbon transmitter and the electro-motograph receiver, more than six hundred lawsuits were fought in the courts between the West-

ern Union, owning the Edison patents, and the Bell Company. The Bell people were charged with pirating the Edison transmitter and retaliated by accusing the Western Union with infringement of the Bell rights. The "telephone war" was a long and costly battle. It was settled finally under a compromise agreement. The Western Union agreed to get out of the telephone field, while the Bell interests agreed to drop all telegraphic enterprises. The Western Union also surrendered its Edison improvements to the Bell Company in exchange for a twenty per cent royalty on the earnings of the Bell system—a concession that was to bring millions of dollars of revenue to the Western Union treasury.

Chapter Seven

HOT MUSIC FROM COLD METAL

"THE boss must be crazy!" muttered John Kruesi in his heavy Swiss-German dialect. He had just returned from Edison's private room in the Menlo Park laboratories, to which the inventor had summoned him, to his own workbench. "What a preposterous idea!"

"What seems to be the trouble, John?" asked Will Carman, the machine shop foreman, good-naturedly. He knew Edison looked upon Kreusi as his most skilled mechanic. Any task that the inventor assigned to him must be something Edison considered specially important. "You look all muddled. What's got you up a tree, anyway?"

"Heaven knows, I don't know what to make of the boss," the perplexed Kruesi replied. He waved a sheet of paper covered with drawings in Carman's face. "He told me to build a model of this thing. Well, I couldn't make out what on earth it was supposed to be. So I asked him. He just laughed and said that . . . Here, you look at it, Bill, and see if you can make any sense out of it."

Carman took the drawing and studied it. He saw a rough sketch of an instrument such as he had never seen. A metal shaft ran through a cylinder, with a crank at one end of the shaft so that one could turn the cylinder by hand. A little tube, containing a parchment diaphragm, or a thin vibrating disk, was at one side of the cylinder. The diaphragm was fitted with a steel needle in the center. It resembled the mouthpiece of a telephone.

"It looks simple enough," Carman observed doubtfully,

after a prolonged examination of the sketch. "It's the simplest machine that I've seen Edison make. But I can't figure it out. What did he say when you asked him what it was for?"

"Of course, he might be pulling off one of his jokes. But he said, 'Kruesi, this machine you are going to build will talk.'"

"It will do *what*?" Carman exclaimed in astonishment.

"It will talk, you know, like you and me, talk!" repeated Kruesi triumphantly. "If the boss were eighty years old, instead of thirty, I'd think his mind was growing soft with old age."

"Here, let me have that diagram again," Carman broke in sharply. "You must have heard him wrong. I'll go and ask him what he really wants."

"Why, yes, Carman, that's what I did tell Kruesi," Edison explained mildly with a twinkle in his eyes. "I really don't see why you and Kruesi think it is such an absurd idea."

The inventor took a long puff on the long, black cigar that he was smoking, before removing it from his mouth. A wrinkle creased his broad forehead and the Grecian nose that was the most prominent feature of his round, good-humored face. Then, occasionally gesturing with the cigar for emphasis, he went on thoughtfully.

"Do you remember that when we were working with the automatic telegraph the paraffin paper gave off a faint humming sound whenever we revolved the machine very fast?" he asked. Carman nodded. "Well, I remembered it, too. When we were working on the telephone, I began to wonder why we couldn't combine the principles of the telephone and the telegraph and make a machine that would talk and record music—a phonograph."

"In the automatic telegraph, we succeeded in recording dots and dashes and then were able to run off the embossed strips whenever we wanted. In the telephone, we convert the human voice into sound waves and back again by vibration.

Now, if we can combine the two, we ought to have a phonograph."

"But, Mr. Edison, I still don't see how this funny-looking diagram you gave to Kruesi can do anything like that," Carman, impressed by Edison's earnestness, despite his early skepticism, pointed out.

"If you watch the surf break on the beach, you will notice that when the water recedes it leaves undulations on the sand. That wavy line at the edge of the waves' penetration gave me an idea. If we have a suitable substance, we can make sound waves, trace an impression on it just as the tides leave a record of hills and valleys on sand."

"But no metal will be affected by the human voice or any other sound," Carman expostulated with the inventor.

"That's right," Edison agreed patiently. "But I think paraffin or tinfoil will." Then he pointed to the cylinder in the diagram he had made for Kruesi. "That's what this is for. We will wrap the tinfoil around it. Then I will speak to it through this tube. Then, when I revolve the machine with the crank, this diaphragm will vibrate and will repeat whatever I say."

"I've seen you do a lot of impossible things, Mr. Edison," Carman said earnestly. "But I still believe that your imagination is running away with you here."

"Maybe so, Carman," the inventor rejoined with a laugh. "But when Kruesi finishes that model I think I'll be able to prove to you that we can make a machine talk. Not only that, but in good time we will have a machine that will play symphonies and whole operas, allow the world to hear again the voices of great men who are no longer living, give a poor farmer an opportunity for entertainment that Nero would have envied."

"A machine like that would be a miracle, Mr. Edison. I'll bet you a box of cigars it just can't be done!"

"It's a bet, Carman. Now run along and tell Kruesi to hurry up with that job. When he's finished the model, we'll see who is right."

"I hope you are, Mr. Edison. It just seems too fantastic to be possible. But if it works, it would be wonderful, simply wonderful!"

Kruesi set to work immediately. He worked all that night without going home for sleep. The next morning he had some coffee and cake that his anxious wife had brought to the shop. Then he returned to his workbench. He was determined not to stop until he had Edison's model finished. If a machine could be made to talk, he wanted to know about it as quickly as possible! After thirty hours of continuous labor, towards the evening of the second day, the bleary-eyed Kruesi walked into Edison's den and announced triumphantly, "Your model is ready, Mr. Edison. Do you want to try it out now?"

"Why, yes, Kruesi. Let's see if we can make it do what I think it will. And just as soon as I take a look at it you can run home and get some sleep. You look terrible."

"Yes, sir. But I'm going to stay until I find out whether you really can make a machine talk!"

Edison put an arm around his star mechanic's shoulders and walked with him to the bench where the model was resting. He studied the large, clumsy contraption with eager anticipation. The workmen in the laboratory all crowded about excitedly, wondering what "the boss" was going to do next.

"Will someone bring a few pieces of tinfoil?" the inventor said quietly.

Edison tested the cylinder and the metal arm of the machine. Then he took a sheet of tinfoil and wrapped it around the grooved cylinder. He began turning the crank, but suddenly there was a loud scratch as the tinfoil began to tear.

Several of the workmen gave expression to their skepticism by laughing.

"Keep your shirt on, boys!" Carman cried out sharply. The foreman, despite his early doubts, was even more anxious for Edison's success than the inventor himself. And he had taken the precaution to bring a neatly packaged box of cigars with him that morning. "Nothing," he told himself, "will give me more pleasure than to give that box to the boss!"

Edison carefully fitted a new sheet of tinfoil to the machine. With Carman's assistance, the ends were glued together neatly to hold the tinfoil taut when the machine was turned. Once again Edison turned the handle. This time the machine revolved smoothly. The tinfoil remained tightly in place. He was satisfied that everything was in order.

"Well, men," he said with a smile to the surrounding group of tense watchers. "I guess we're ready. Here goes!"

He started to turn the crank. As he did so, he leaned over the mouthpiece and, in that robust voice to which his years as a train candy butcher had given such unusual power, began to recite that old childhood favorite:

Mary had a little lamb,
Its fleece was white as snow,
And everywhere that Mary went
The lamb was sure to go.
"What makes the lamb love Mary so?"
The eager children cry.
"Oh, Mary loves the lamb, you know,"
The teacher did reply.

Then Edison returned the cylinder to the starting point. Once again he began to turn the crank. This time he remained silent. But the machine did not! Faintly, but distinctly, it repeated in Edison's familiar voice:

Mary had a little lamb,
Its fleece was white as snow . . .

There was an awed silence in the laboratory. Kreusi, already weakened by his long vigil, almost fell over in his fright. It seemed incredible! But the hushed workmen could hear the machine talk for themselves. They had to believe their own ears! The spectacle left them weak with amazement and admiration.

Carman was the first to recover from his stupor. He turned on his heel and walked over to his desk. He returned and handed the package of cigars to Edison.

"I've never been so happy to lose a bet," he said. "But I must admit that this wonderful machine makes me scared."

"I must confess that I'm a little scared myself," Edison replied. Then he turned to Kruesi with a grin, slapped him on the back happily, and said, "Here, you say something to the machine!"

The night wore on. No one in that room dreamed of leaving for home. Wild excitement and jubilation had replaced the dumbfounded silence with which they had greeted the birth of the phonograph. Each wanted his turn to talk into a little piece of tinfoil and have his voice thrown back at him. Edison ripped open his newly-won box of cigars and after taking one himself passed the rest to the others. They talked into the machine, sang and whistled. Each time the phonograph faithfully reproduced the antics of the human beings who hovered over it.

Dawn finally broke. The sun rose into the clear sky of a beautiful Autumn day. About nine o'clock, Edison chased everyone home to get some sleep. But he did not follow his own advice. Instead the sleepless inventor wrapped up his phonograph, put it under his arm and headed for New York City.



The hushed workmen could hear the machine talk

Shortly after ten o'clock he walked into the office of A. E. Beach, the editor of the Scientific American, whose journal was regarded at that time as the foremost authority among scientific publications. Beach had just arrived at his desk from a bountiful breakfast, freshly shaven and immaculate. In contrast, the bearded Edison looked like a tramp who was carrying a bundle of clothes under his arm. Had he not been so well known to the staff he would never have gained admittance into the editor's sanctum.

As it was, Edison's strange appearance created a great stir. Everyone was immediately aware that the noted inventor must have created something new and sensational. They eagerly edged into Beach's office to watch Edison as the inventor carefully set his parcel on the editor's desk and began to unwrap it. The onlookers were disappointed when they saw the odd-looking and unimpressive device.

"Why, what on earth is that funny-looking thing?" Beach asked in a bewildered voice.

Edison smiled. "Hold your horses a minute and you'll find out," he said jovially. When the inventor had the machine completely uncovered and set to his satisfaction, he pushed it gently toward Beach and said, "Here, give this handle a twist and see what happens!"

Beach did as he was ordered. He nearly fell over his desk in astonishment.

"Good morning, Mr. Beach," the machine said. "What do you think of the phonograph?"

Edison grinned happily over the success of his little joke. Beach and his associates took turns in talking to the machine and hearing it talk back to them in their own words. News of what was going on quickly spread. Excited reporters arrived breathless to crowd into the room. Edison was kept busy demonstrating his invention for two hours. By that time

Beach's office was so jammed that the editor began to fear that the floor would give way under the terrific pressure. He begged the inventor to put his fascinating invention away.

The whole world was agape the next morning when the newspapers announced that Edison had created "the greatest invention of the age—a machine that talks." Few announcements have ever created such a sensation.

Everyone wanted to hear and see the weird instrument that could capture speech and music, reproduce them at will or preserve them for centuries. Thrilled and curious thousands of men and women made the pilgrimage to Menlo Park to see and hear the phonograph for themselves. The Pennsylvania Railroad had to run special trains to accommodate them. Edison became the pet subject of the cartoonists, who loved to picture him in black flowing robes and the picturesque cap like an inverted ice cream cone of the mysterious alchemist of medieval times, snatching miraculous secrets from the thin air!

A telegram from Washington asked Edison to demonstrate his celebrated invention to the members of Congress. Accordingly, the inventor put the phonograph under one arm and hopped a train for the national capital. There, a brilliant gathering of gray-bearded Senators and other dignitaries surrounded the youthful "wizard" to marvel at his talking machine. As excited as young boys, each was eager to speak to the instrument and to hear his own little oration echo from it a few moments later.

Edison was treated like a hero. He was aglow with pride at the dazzled amazement his invention had caused among the members of Congress and at the wonderful predictions they made for it. Tired and hungry, he was near exhaustion when about eleven o'clock that night, just when he was about to beg to be allowed to retire to his hotel for some rest, an urgent

message was handed to him. It was from the White House. It read, "President Hayes would consider it an honor if Mr. Edison could come to the Executive Mansion immediately."

The President of the United States and Secretary of State Carl Schurz, who was visiting the Chief Executive, were no less wonder-struck and pleased with the phonograph than the celebrities at the other end of Pennsylvania Avenue had been. In spite of the lateness of the hour, President Hayes went to the bedroom of Mrs. Hayes and awakened her to tell her about it. Mrs. Hayes hurriedly dressed, aroused the other guests, and all descended to see for themselves the tantalizing device. It was not until a White House clock was chiming four o'clock the next morning that Tom Edison was allowed to leave.

Many incredulous people refused to believe in the phonograph. Edison, they were convinced, was a "tricky charlatan" and his invention a "hoax." These suspicious unbelievers were certain that the youthful inventor had a ventriloquist in his employ. It was this ventriloquist, these skeptics affirmed knowingly, who actually spoke the words that issued from Edison's machine.

Among these doubtful critics was Bishop John H. Vincent, the founder of the Chautauqua Movement. Bishop Vincent took the rostrum to describe the idea of a talking machine as "incredible" and to accuse Edison of being "a conscienceless fraud." The unruffled Edison good-naturedly invited Bishop Vincent to Menlo Park to examine the phonograph for himself.

Even for a Bishop, however, Edison would not put on good clothes. When the dignified churchman arrived, he found the noted inventor grimy with dirt and oil, his unshined shoes edged with red Jersey mud and his collarless shirt covered with soot. A cigar in one corner of his mouth, the inventor was

busy at a workbench just like any one of his employees. With Bishop Vincent was a tall pleasant mannered gentleman by the name of Lewis Miller. Mr. Miller, who came from Akron, Ohio, was the inventor of the mowing machine and grain binder. He and Edison took an immediate liking to each other. Years later, that friendship was to lead to Edison's second marriage.

Edison escorted his distinguished guests to one of the improved models of the phonograph. The Bishop watched Edison's every move. If the inventor made any signal to any hiding ventriloquist, the Bishop was ready to pounce upon the confederate and expose the "hoax" that was being put over the world! Edison was humorously aware of the suspicious eyes that followed him. He was enjoying the situation.

Stepping up to the mouthpiece of the phonograph, Edison began reciting from one of his favorite poems. He thought the Bishop, too, would like the immortal lines from Gray's "Elegy in a Country Church-Yard":

Let not ambition mock their useful toil,
Their homely joys, and destiny obscure;
Nor grandeur hear with a disdainful smile
The short and simple annals of the poor.

The boast of heraldry, the pomp of pow'r,
And all that beauty, all that wealth e'er gave,
Awaits alike the inevitable hour.
The paths of glory lead but to the grave.

As the phonograph repeated the famous verse in Edison's unmistakably rich tones, Bishop Vincent was obviously impressed. The triumph of reality over religious skepticism became complete when Edison mildly suggested, "Perhaps you would like to speak to the machine yourself, Bishop Vincent."

As the inventor beckoned him towards the mouthpiece, the Bishop stepped up eagerly. In a firm, sonorous voice, he began calling out the most difficult Biblical names he could remember at a breathless speed—Methuselah, Moses, Abraham, Mahaleel, Hazarmaveth, Solomon, Chedorlaomer, Rebecca, Matthew, Midianitish. The phonograph repeated the string of tongue-twisting names faultlessly.

"I'm satisfied," the good Bishop exclaimed pontifically. "There isn't another living man who can say those names as smoothly and as fast as I can!"

Like all parents, Edison looked upon his firstborn as a unique creature. Marion was a pretty child at the time of the invention of the phonograph and the fond father was anxious to make a record of his little girl's crying. That record of the wails of his firstborn, he thought, would be a source of great amusement in his old age. The busy inventor hustled out of the laboratory one afternoon with a phonograph. He carried it to his home and entered the baby's nursery. He started the machine and then carried "Dot" in front of it. But the baby wouldn't cry! Edison tumbled the youngster about, rumpled her hair, made horrible faces at her. The baby gurgled happily. She seemed unable to make up her mind as to whether the strange machine or the inventor was more entrancing!

For several days, the busy inventor transported the phonograph back and forth from the laboratory to his home. Each day, the baby seemed to grow more cherubic. Nothing would ruffle her good nature, not even when she was suddenly awakened from sleep. The baffled Edison's temper became more frayed as that of his child became more mellow. In desperation, he decided to take advantage of the absence of the nurse from the nursery. He bared the chubby leg of the infant, shut his eyes tight and made ready to bite the tender flesh. Mary

Edison, puzzled by the strange noises in the nursery, happened to peep into the room at this fateful moment.

"Thomas Alva Edison!" she called out in an anguished voice.

The inventor breathed a mighty sigh of relief. He smiled apologetically at his wife. "I was hoping to make a record of Marion crying—the first record of a baby's cries—but I guess it's no use," he explained. "She's feeling too good!"

Mrs. Edison smiled understandingly as the inventor gathered up his paraphernalia.

As Edison made his way to his laboratory, he decided that recording his baby's voice was a lost cause. At least, he mused philosophically, she would grow up to have a beautiful personality. However, weeks later, Mrs. Edison visited the laboratory with the baby in her arms. When the baby heard the big machinery roaring, she began shrieking her displeasure.

"Quick, stop the machinery," shouted the inventor. "Start the phonograph."

The record that he wanted so much—the only one in the world of a baby's cries—was at last his!

Edison filed a patent for his phonograph in December, 1877. Washington granted it—No. 200,521—very quickly, on February 19, 1878, with the observation that the invention was so unique that its files showed that no other attempt had ever been made to mechanically reproduce the human voice or any other sound.

But Edison was far from satisfied. He knew that his phonograph still was a very crude instrument, a mere shadow of what it ought to be. So he set to work to perfect it. His phonograph research was to extend over many years of his life, and to cost more than \$3,000,000, before it led to his goal—a machine that would flawlessly reproduce a whole symphony so that if a listener were to sit in a concert hall in the dark he

would not be able to distinguish between a record and an orchestra.

First of all, the inventor decided that tinfoil was an unsatisfactory medium for recording. He began experimenting with wax. He obtained samples of almost every known fat in the world, melting, blending and mixing a hundred different varieties. He finally succeeded in making a record from a combination of waxes that faithfully recorded sound-waves without distortion. But the record was costly and broke too easily. Discarding wax, he tried stearin—a white crystalline compound derived from animal fats, particularly from the fat in cows' milk, that was used extensively in the making of soap and candles. It proved to be the answer to his prayers. With this new material, Edison made a record that was exceedingly hard and indestructible but had a surface so smooth that it would reproduce sound without any of the rasping and scratching sounds of the early records. In the ten years from 1887 to 1897 Edison obtained eighty new patents on his phonograph and the improved machine that resulted from that decade of unremitting research gained an immediate and tremendous popularity. It became a major source of entertainment and happiness the world over.

England's Queen Victoria, Germany's Kaiser Wilhelm and Russia's Czar Alexander shared with the modest New York garment worker, the humble Pennsylvania coal miner and the isolated cow puncher in Texas a yearning to hear and to own the magical instrument. England's great Prime Minister Gladstone was among those who attended the first public exposition of the new Edison phonograph in London. He was enthralled. He gladly accepted an invitation to say a few words that would be recorded and sent back to Edison in Menlo Park.

"I am profoundly indebted to you for, not the entertain-

ment only, but the instruction and the marvels of one of the most remarkable evenings which it has been my privilege to enjoy," Mr. Gladstone said.

"Your great country is leading the way in the important work of invention. Heartily do we wish it well; and to you, as one of its greatest celebrities, allow me to offer my hearty good wishes and earnest prayers that you may long live to witness its triumphs in all that appertains to the well-being of mankind."

The German Emperor was so taken with the phonograph that he insisted on learning just how it worked. An Edison engineer gave a special demonstration in the Emperor's private apartments. He took the machine apart and put it together again. The Emperor wanted to be able to do that also. He would not allow the Edison representative to depart until he had learned to take the phonograph to bits, and make it whole again, and was satisfied that he understood just what each bit was intended to do in the completed mechanism. Thereafter, the Emperor loved nothing better than to give his own demonstrations with the phonograph to his Court. Many of the ladies thought that the Emperor was even more wonderful than the almost supernatural phonograph!

Thomas Edison was pleased with the new honors that the phonograph was winning for they proved the universal appeal of the instrument. His conviction that the phonograph would become a part of the daily lives of peoples all over the globe was strengthened by an intriguing report from far-off Tibet.

Lhasa, Tibet's capital and sacred city of the Buddhist faith, was a strange and fabulous city supposedly forbidden to a European or to anyone not a devout Buddhist. The Buddhists in Lhasa spent much of their time in religious devotions and in mechanically repeated prayers. A Burmese merchant thought he might make a fortune if he could introduce the

phonograph among the Buddhists to be used to repeat their prayers aloud for them.

"He succeeded in getting the Grand or Dalai Lama and the dignitaries that surround him to inspect the phonograph," the report to the amused Edison said. "As he had read into it a chapter of the sacred writings of the Buddhists, he was able to make it repeat this chapter aloud, to the great astonishment of the Grand Lama, who thought he was witnessing a miracle.



The merchant asked the Dalai Lama to speak into the machine, and he did so, declaiming the beautiful prayer called 'Om mani padme cum,' or 'Jewel in the Lotus.' The phonograph repeated the prayer in the Dalai Lama's voice, to the stupefaction and great edification of all the auditors. For many days thereafter the phonograph was kept busy with this and utterances holy to the Buddhists, and now the phono-

graph has taken its place as the favorite 'praying machine' of Lhasa."

If a magic carpet could have transported the revered Grand Lama from Tibet over the formidable Himalayas and across half the world to Menlo Park he would have been dumbfounded by the sight of even a greater miracle than the phonograph!

Chapter Eight

A TILLER IN GOD'S VINEYARD

In the beginning God created the heaven and the earth.

And the earth was without form and void; and darkness was upon the face of the deep.

And God said, Let there be light; and there was light.

And God saw the light, that it was good; and God divided the light from the darkness.

And God called the light Day and the darkness he called Night.

Genesis

MARY EDISON set her coffee cup down upon the breakfast table with a gentleness that belied the anxiety she felt. The problem, she knew, was how to broach the subject to her famous husband so that he would be persuaded by what she said rather than offended.

"Tom," she began hesitantly, "don't you think you've been working very hard of late?"

"Well, I don't know," was the placid reply, "I hadn't thought about it and besides . . ."

"Why, one time last month you weren't home for three nights!"

"I had forgotten but I guess you're right. That was the time we were trying to take the bugs out of one of our new phonograph models. But hard work never hurt anyone. And I enjoy it."

"But, Tom, don't you think you'd enjoy it more, don't you

think it would be better for you, if you took a good rest, a— a little vacation!”

“Why, Mary, I haven’t taken a vacation since I started working as a train boy at eleven. I wouldn’t know what to do with one.”

“There, I knew it. Twenty years of hard work without a vacation. You might not realize it but this terrific pace is telling on you. You look tired and you’ve been very irritable and cranky lately.”

Tom Edison looked affectionately at his wife and noted the wrinkles of anxiety in her face. He leaned over and patted her arm.

“Maybe you’re right, Mary,” he said. “As a matter of fact, I have been feeling rather low recently. I was wondering what was wrong with me. Perhaps a few days away from the shop would do me good.”

“You need more than a few days,” Mary Edison put in firmly. “You ought to take a few weeks or even months and go away for a long trip. A change of scenery would rejuvenate you!”

“It’s strange you should say that. It’s exactly what Professor Barker wrote in his letter inviting me to go on a trip to Wyoming.”

“That would be wonderful,” his wife exclaimed happily. “You ought to go.”

“There is going to be a total eclipse of the sun out there in July. A group of scientists from the University of Pennsylvania, Princeton and Columbia are going and Barker wants me to join the party. Since you’re so anxious to get rid of me . . .”

“Yes, I am, this once,” she broke in affably. The smile on her face matched the sly look on his. They both broke into easy laughter. For the first time in weeks Mary Edison felt

carefree. Her victory had come with much greater ease than she had dared to hope.

But a vacation to Tom Edison did not mean quite the same thing it did to other men. Not even when it was the first vacation in twenty years. His wife was right. His health had been impaired by his ceaseless round of hard work. The trip to watch the eclipse would be pleasant and relaxing. It would also afford an opportunity for interesting experiments!

When the time came for the eclipse party to leave, Edison had a new invention. He called it the tasimeter. It consisted of a carbon button between two metallic plates, with a rod of hard rubber pressed against the plates. The two plates and the carbon button formed part of an electric circuit containing a battery and a galvanometer. The hard rubber was exceedingly sensitive to heat. The slightest warmth caused it to expand and to press the plates more closely against the carbon button. This created a change in the resistance of the electric circuit. The galvanometer immediately registered the change. Edison hoped to use his tasimeter to measure the heat coming from the sun's corona.

As the inventor waited for the eclipse party to organize, he tinkered with a number of other inventions on which he had been working. These, for the most part, were more interesting than practical.

There was, for example, the phonomotor or vocal engine. This was born from Edison's experience with the telephone. One day, a friend humorously suggested to the thirty-one year old inventor that he should try inventing a machine that would drill a hole through a board of wood when one spoke into it. To Edison, the idea was not funny.

"I will," he replied quickly.

Within a few days he had invented a simple device with a mouthpiece and a diaphragm attached to a brass rod carrying a steel pawl. The vibrations of the voice, acting on the dia-

phragm, produced mechanical motion through driving a wheel. The odd contrivance was quite capable of boring a hole through a board or even to saw wood. The world, however, received this news with unruffled calm.

"We consider the machine of very little utility," one ironic editor commented acidly, "as we are familiar with voices that can accomplish that feat without any mechanical aid!"

More useful was the megaphone, which proved valuable as a means of conveying sound to distant points. Edison's microphone extended the principles of his carbon transmitter to magnify sound in another way. His ear trumpet was designed to aid the hearing of the deaf, a project that his own deafness had put close to his heart. By replacing the rod of rubber in his tasimeter with a strip of gelatine Edison produced the odoroscope. It was so sensitive that a drop of perfume on the floor caused a wide swing on the galvanometer. The principles underlying the tasimeter and the odoroscope led to the construction of barometers, hygrometers and similar instruments of great sensitiveness and delicacy.

As Edison was packing his bags for the trip to Wyoming a gift arrived in the mail from his friend Jay Gould. Gould controlled the Union Pacific Railroad in addition to being interested in Western Union, the company that had utilized Edison's telegraph and telephone inventions. The gift was a railroad pass. It gave Edison the privilege of riding anywhere he pleased on the Union Pacific. What pleased Edison particularly was that this privilege also allowed him to ride the cowcatcher of the locomotive. And it was precisely on that precarious perch in front of the engine that the inventor made a large part of his trip to Wyoming! He maintained that vantage point even after the train hit a bear and the body of the animal missed him by inches as it hurtled past him. Despite the pleadings of his anxious traveling companions, he refused to desert that post. However, when the train passed

through the snowshed on the summit of the Sierras in the Rocky Mountains, Edison was finally driven into the cab of the engine by the intense cold.

Astronomers from all over the globe were gathered to witness the eclipse on July 29, 1878. Edison's tasimeter attracted almost as much attention among them as the great spectacle of the universe they had come thousands of miles to study. As the moon, traveling its celestial path through the star-spangled heavens, slid between the earth and its source of light and energy the disk of the sun grew smaller and smaller. At the same time a strong wind that had set in grew more violent. Edison, who had connected a four-inch telescope to his tasimeter, was afraid his device would be smashed by the gale. A dozen astronomers pitched in to help him to gather some lumber. Working with great speed, they used the wood to fashion a rudimentary structure to support the tasimeter firmly. Their task was barely finished when the moon's shadow completely blotted out the face of the sun. Night seemingly had fallen in the middle of the afternoon. The solar corona, visible to the human eye for a few moments during the period of total eclipse, burst forth in all its awe-inspiring beauty. The perspiring Edison managed to concentrate the light from the mysterious corona on the small opening of his device. The galvanometer on the tasimeter swung sharply to the right. The sun had yielded one of its many secrets! And scientists had gained a new tool with which to plumb hitherto unexplored regions of the universe.

On their homeward trip, Professor Barker, Edison and some of their friends decided to visit Yosemite. Edison's eager, restless mind was stirred by the sight of miners drilling and boring with great difficulty near a river. He turned to his friend "Barky" and pointed to the toiling men.

"What a waste of time and energy," he exclaimed. "How

much simpler their work would be if the power of that waterfall were put into their hands with the aid of electricity!"

"Yes, that would be a wonderful gain, not only for these miners but for the whole world," the Professor agreed. "The man who succeeds in solving the problem of harnessing electricity will be one of mankind's greatest benefactors."

"I believe the day is coming when all our great waterfalls will become sources of electric power," Edison said enthusiastically. "Not only that, but I believe that a means will be found to utilize them to give us electric light for our homes and factories. There is no reason why we should not have electric lamps to replace those evil-smelling gas lamps that we must use today."

Professor Barker found his friend's enthusiasm for electricity contagious. "Tom, it's strange that you should say that," he exclaimed. "A friend of mine, Bill Wallace, has been working in his place at Ansonia in Connecticut to make an electric lamp. He's asked me several times to visit him to take a look at his experiments. How would you like to stop over on our way back to see what he has been doing?"

"I'd be delighted," Edison quickly replied.

Edison and Professor Barker received a warm welcome at Ansonia. The inventor was greeted as a fellow scientist by Wallace and his aides. The Ansonia investigators were experimenting with the arc light. This form of illumination was first developed by a young Englishman, Humphry Davy, in 1808. Davy took two sticks of charcoal and passed an electric current through them. The little blue-silvery bow of light formed an "arch" as it wavered between the glowing pieces of charcoal and so Davy called his invention the "Arc" light.

Such skilled scientists as Thomson, Brush, Hewitt and the Russian engineer, Jablochoff, took up Davy's discovery and sought to improve it. Jablochoff in 1876 invented a crude arc-

lamp which became known as the "electric candle." It consisted of two thin strips of carbon, instead of charcoal, but essentially it was the Davy "arc" light. It created a tremendous sensation when first introduced but was impractical. The Jablochhoff light, like all the other arc lights, burned with the full power of electricity that passed through. The result was a hot light that burned with a dazzling glare that almost blinded the eyes. It quickly burned itself out.

This was as far as inventive genius had been able to develop the electric light. Wallace and his associates were hopeful of overcoming the two major defects of the arc light—its great heat and its extremely short life. They were happy to show Edison what they were trying to do.

Edison, in his turn, was enraptured by what he saw. It was the first time he had seen an electric light. He darted from one arc lamp to another, eagerly asked numberless questions, sprawled over a table like a child to make all kinds of calculations. With the swift vision of genius, he grasped the weakness of the arc light at once.

"I do not believe that you are working in the right direction," he pointed out with blunt frankness. "The secret of making an electric lamp that will work is not to reduce resistance to the electric current, as you are trying to do, but to increase resistance. To chain the electric current, we must learn to subdivide it. We don't want a large, blinding light. What we need is a simple lamp that will give a small light having the mildness of gas. In my opinion the only way you can do that is to subdivide your electric current, then divide it some more, until a small portion of your original power enters any one lamp."

Wallace was frankly skeptical. "Mr. Edison, I believe in the arc light," he said. "I do not believe that the electric current can be subdivided. That is an impossible task. But if

you think you can do it, I wish you all the luck in the world."

"I believe it can be done," Edison retorted, as he shook hands in friendly parting. "When I get back to my laboratory, I shall prove it!"

Edison returned to Menlo Park in a buoyant spirit. He told Mary Edison that he felt "reborn" after the vacation she had insisted on his taking. Refreshed in body, the former train boy, who had turned his father's cellar into a chemists' laboratory at the age of 11, had become possessed with his greatest dream. He had no doubt that he could snatch from Nature's innermost citadel the secret of how to subdivide electricity, of how to make a lamp that would, at the pressure of a finger, turn night into day.

The world did not share Edison's confidence. The most eminent scientists of the day openly laughed at his idea. They dismissed what Edison sought to do as "impossible." The inventor was "ignorant," a "dreamer," or perhaps a "humorist," a "boaster," and a "fool."

Edison was unruffled by all this name-calling. He added fuel to the flames of criticism by telling an inquisitive reporter from a New York newspaper that he was building a new brick machine shop at Menlo Park to make the new electric lamps he had in mind.

"Some day," he predicted, "we shall turn the power of steam into electricity. The greater the steam power, the more electricity. A few electric plants throughout a big city will give us enough electricity to light every home and factory. A simple screw will turn on the electric light in your home. It will be whiter and steadier than any known lamp. It will have no obnoxious fumes or smoke, will be one of the healthiest lights possible and will not blacken ceilings or furniture."

Finally, Edison predicted that this new vision of his would

be a reality within two years. His interview caused a serious panic in gas securities on the stock market. Some gas stocks tumbled as much as twelve points. Prominent scientists rushed into print to describe Edison's statements as "a fairy tale" and his claim that electricity could be subdivided as "incompatible with the well-proven laws of the conservation of energy." The British Parliament was told by one of its committees, which had called many of England's foremost scientists before it, that the gas companies had nothing to fear.

"The subdivision of the electric light," the committee solemnly reported, "is a problem beyond the power of man to solve."

One of the world's greatest scientists, however, rose in favor of Edison. Professor John Tyndall took issue with Sir William H. Preece, England's foremost authority on electricity, when the latter publicly condemned Edison and said that "the subdivision of electric light is an absolute *ignis fatuus*."

"I cannot agree with you," Dr. Tyndall remarked. "Edison has the penetration to seize the relationship of facts and principles and the art to reduce them to novel and concrete combinations. Though he thus far has accomplished nothing new in relation to the electric light, an adverse opinion as to his ability to solve the complicated problem on which he is engaged would be unwarranted.

"Knowing something of the intricacy of the practical problem, I should prefer seeing it in Mr. Edison's hands than to have it in mine!"

Meanwhile, back in Menlo Park, Edison had already plunged into his seemingly superhuman undertaking. The whole world might doubt his success but he himself did not. Such was his fiery faith in himself that he simply would not even consider the possibility of failure.

He began his epic hunt by making an exhaustive study of the history of lighting. He filled 200 notebooks of more than

40,000 pages with notes and diagrams of his research in gas illumination. Heat and light, he found, were indistinguishable from the very beginning of man's efforts to turn the darkness of night into the light of day. Fire was the first source of light. The caveman learned that certain kinds of wood and rushes would burn more brightly and last longer than those which he needed merely for cooking. These became the first "lamps." Rushlights were still in use for illuminating theatres in the days of Shakespeare. When splinters of wood were soaked in oils and other fatty substances a still better light was achieved. The adventurous Phoenicians invented the wax candle. The discovery of petroleum and gas, many centuries later, opened a new chapter in the history of lighting—and of civilization. Gaslight was the most common and the most popular illumination available when Edison began his search for the electric light.

The inventor quickly decided to discard the arc light. The arc light, he was convinced, would never become practical. The hunt for the electric lamp called for an entirely new approach. Edison made up his mind that success lay in making a lamp that would become incandescent, or luminous, as a result of the heat passing through it. But since heat carried its own destruction with it, his problem was to make the lamp incandescent without having it crumble into ashes at the same time.

Edison made fine threads of various heat-resistant materials. He inserted these filaments into glass vessels. The first lamp thus made lasted eight minutes before burning out. He tested the whole list of rare metals—barium, rhodium, ruthenium, titanium, zirconium and platinum. Platinum yielded the most encouraging results. Edison became hopeful that platinum, with a melting point of about 3,191 degrees Fahrenheit, could be made incandescent without melting.

He wound a double spiral of platinum wire and then placed

it in a glass tube. Next, he invented a "regulator" which he attached to the lamp. When the heat inside the lamp became too intense, this device expanded and short-circuited the spiral. Now Edison turned on the current. The spiral gave a good light when heated close to the melting point of platinum. Then the regulator stepped in, short-circuited the lamp and cooled it down. As the cooling progressed, contraction set in, the electric circuit reopened and the lamp became bright again. It was an ingenious scheme. But Edison was the first to pronounce it unreliable and impractical.

"We must get something better and we will," he told his aides confidently.

He sat patiently at an oblong table on the second floor of his laboratory, day after day, week after week, month after month, making numberless experiments. All proved failures. He knew that a successful incandescent lamp would have to register at least 200 ohms or units of electrical resistance. But so far the best he had been able to get was about four ohms of resistance. The result was that all his lamps burned out almost as quickly as they became illuminated.

But Edison never lost heart. There were many jeers at his lack of success. But his thousand-and-one disappointments merely caused him to redouble his efforts. One night, after a particularly exhausting and cheerless day, a brilliant idea took shape in his mind. The more he thought about it, the better the idea seemed. He jumped out of his seat and called one of his aides.

"Jehl, do we have a pump in the place?" he asked.

"Yes, I believe there's a hand-pump around here someplace," was the surprised reply. "I don't believe it's much good."

"Have one of the workmen go for it right away. I've got an idea that one reason why our lamps burn out so quickly is

because we have been lighting them in the open air, where the oxygen in the atmosphere oxidizes them. Get that French glassblower to make some completely enclosed bulbs. You know, have them look like medium-sized pears. Then bring them and the pump to me."

The workman with the dust-covered pump and Jehl with a handful of the new bulbs arrived at Edison's desk almost simultaneously. A coil of platinum was placed inside one of the new bulbs. Then Francis Jehl applied himself to the handle of the pump vigorously. He forced out as much air from the bulb as possible. He made the vacuum as complete as could be obtained with the only available pump. Then Edison turned on the electric current. The same amount of electricity that previously produced a light of five candlepower now gave a light of twenty-five candlepower without melting!

Edison had discovered one of the basic principles of the incandescent lamp—the vacuum bulb! Now he turned his attention to making a pump that would give him a better vacuum. His improved pumps enabled him to make bulbs with an almost perfect vacuum. Only one-millionth part of atmosphere was left behind. Scientists had not dreamed such "emptiness" was possible. A better and longer-lasting light was the result.

However, the vacuum in the bulb did not remain constant. It began to fill up, as if air were leaking into the bulb, after the electric current was turned on. Edison was mystified. Experiments with the bulb, the pump and the process of creating the vacuum all revealed that there was no possible way for air to filter into the bulb once that air had been expelled. So Edison concluded that the platinum metal inside the bulb gave off gases when heated. These gases were disturbing the vacuum. A second application of the pump was ordered. Again Edison was right. Once the gases shed by the metal were

expelled from the bulb the platinum wire became harder and more homogeneous. It burned more brightly. It resisted the ravages of heat better.

Still another Edison inspiration improved the lamp immeasurably. He coiled the filament in such a manner as to offer great resistance to the passage of the electric current. At the same time, the newly-shaped filament presented a slight surface, less than three-sixteenth of an inch, from which radiation could take place. This alteration multiplied the lamp's resistance. The lamp now offered 100 ohms of resistance without burning up instead of the four ohms at the beginning of his quest to capture the secret of electric lighting.

But Edison was not satisfied. His lamp, despite all advances, had a life span of minutes. He wanted a lamp that would burn steadily for hundreds of hours!

The inventor regretfully concluded that platinum was not the ideal filament. It never would be. Despite its great tensile strength, it was too brittle in the electric lamp. It broke constantly. Since platinum was one of the most expensive of metals, this factor alone prohibited its use on an extensive scale.

Edison knew that his hunt for a practical electric lamp had now narrowed down to a search for an inexpensive substance that would make a filament that would defy a strong electric current. Where in the limitless realm of Nature was that substance hidden? He mobilized his laboratory forces, like a general mapping a campaign to capture an enemy citadel, to find the answer. The strategy was simple. Every conceivable substance was fashioned into a filament. Then it was inserted into a lamp. The current was turned on. Could the new filament take it? Each time the question was asked, the answer was the same. As each filament, with monotonous regularity, melted

away before the onslaught of electricity, hope gave way to dejection.

Months passed. The snows of Winter vanished into the land and shy crocuses and gay tulips sprang with unfolded arms to embrace the zephyrs of Spring. Then the hot breath of Summer sent weary millions to the cool seashore or to the pine-scented mountains for relief from the heat wave. But not Edison.

He and the small band of tireless men whom he directed kept at their workbenches. They labored night and day, unflinchingly, like men possessed. The inventor's aides had caught his contagious enthusiasm. They, too, were certain of ultimate success. When anxiety and dejection sometimes replaced hope and confidence Edison's cheerful and unconquerable spirit made them feel ashamed. They set to their tasks with renewed determination.

Edison's eyes began to suffer. A year had elapsed since he had boldly announced his intention to invent an electric lamp. Fall had arrived again. After twelve months of constant exposure to the searing rays of electricity, his eyes begged for rest. They pained him almost beyond human endurance at times. He confided to his notebook what he would not admit to his associates or to his wife, "Suffered the pains of hell with my eyes last night from 10 P.M. till 4 A.M. when got to sleep with a big dose of morphine. Eyes getting better and do not pain much at 4 P.M.; but I lose today."

To add to his troubles, Edison's financial backers were becoming restive. When the inventor had begun his investigations, a group of bankers, including J. Pierpont Morgan, had organized the Edison Electric Light Company. They had pledged \$50,000 to support his experiments. Now that money was running out. The bankers were losing faith. They told

Edison bluntly that no more money would be forthcoming unless he demonstrated some practical results.

Twilight on October 19, 1879 found the inventor at his desk on the second story of his tabernacle-like laboratory. He was lost in thought. It was Sunday and few of his aides were around. The fading rays of the sunset added a velvety sheen to the bronze and gold and red of the trees outside and sent a bright shaft of light slanting through the windows, like an arrow, to his desk. Edison was tired. For the first time in the arduous thirteen months he had devoted to the electric lamp he felt discouraged. Was that light dangling on his desk mocking him? Light had been called "Heaven's firstborn"—was any attempt by mere man to capture it doomed to failure?

The inventor plunged his fingers through his unkempt, bushy hair with a gesture of irritation. He threw away a half-smoked cigar. Absent-mindedly, he took another out of a vest pocket, bit off the end savagely and stuck it in his mouth. What was wrong? They had tried every imaginable substance to find a suitable filament. Nothing worked. There *must* be somewhere in the world a material that would take an electric current without melting. Night fell. Edison continued to ponder his problem in the stillness that had engulfed his laboratory.

Suddenly, he jerked his head to look at his hand. He was surprised to find that while his mind had been far away in thought his nervous fingers had strayed to a little pile of lamp-black, which was being used in connection with the making of telephone transmitters. While his mind had wandered in a brown study, his fingers had mechanically fashioned a little piece of lampblack until it looked like a slender filament.

Edison studied it with amazement. His face lost its tenseness as an idea took shape in his mind. His nervousness vanished and a feeling of excitement took hold of him. Lampblack

contained carbon. Carbon gave a beautiful, steady light. But carbon also united with oxygen with the greatest of ease and burned away almost as quickly as it received an electric current. For that reason carbon had been discarded at the very start.

"But," Edison recalled with a sense of mounting enthusiasm, "that was before we had a vacuum bulb. A vacuum prevents oxidation."

The inventor jumped off his chair. Charles Batchelor, one of his assistants, was working quietly in a corner of the shop, waiting for "the boss" to finish the day's work.

"Batch," Edison called out, "come here a minute. I've got an idea and I want to try it out right away."

"Yes, chief. What do you want me to do?"

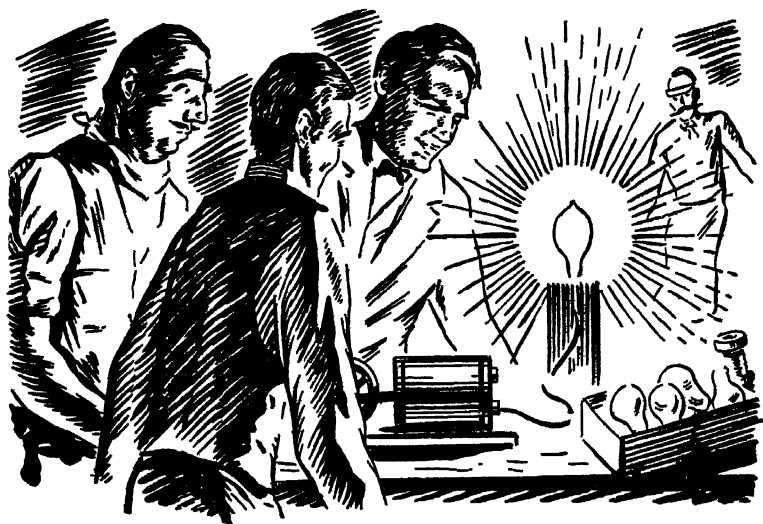
"Get a spool of thread. Then take small pieces of thread, bend them into the shape of a double hairpin and put them in a muffle furnace for an hour to carbonize them. I want to see how they will act as a filament. We've tried everything else."

To fit the delicate carbonized thread into a lamp proved a heartbreaking ordeal. Sometimes a thread broke when removed from the furnace. Other times it split into pieces while being carried, no matter how carefully, from the furnace to the lamp. Worst of all, some threads shattered while being placed in the lamp.

Finally, a fragile carbonized thread was successfully sealed in a bulb. The pear-like bulb was exhausted of air. Then, Edison slowly turned on the electric current.

The lamp suddenly glowed like a dazzling bit of sunshine! Edison and Batchelor watched it with fascination. They measured the lamp's resistance and found it was 275 ohms—more than enough. Then they sat down to see how long it would last before burning out. They sat and looked. Other workers

who had heard the news quietly entered the laboratory to watch, too. They waited fearfully. The suspense grew by the hour. Would some internal upheaval, some convulsion, herald sudden death? But the lamp did not die. It kept on burning merrily, hour after hour. As it continued to burn, anxiety gave way to elation and finally to exuberant rejoicing.



Edison did not go home that night. Nor the following night. The thought of sleep never occurred to him. The fragile filament of carbonized cotton rewarded "the death watch" by doing what the strongest of metals had been unable to do. It burned for forty-five hours. Then, on Tuesday afternoon, with a suddenness that was startling, the light vanished.

"If it will burn forty-five hours now, I know I soon can make it burn a hundred!" Edison cried triumphantly.

Chapter Nine

BOTTLED SUNSHINE

THE managing editor of The New York *Herald*, Thomas Connery, strode into the office of his subordinate, the city editor, angrily waving a copy of the paper which had just arrived at his desk from the press room. Christmas was only four days away. But there was none of the traditional holiday spirit of peace and good will in his manner.

"How on earth did this hokum get into the *Herald*," he shouted. "We shall become the laughingstock of the world. Who is responsible for this?"

Albert Orr, the city editor, drew his head back out of reach of the newspaper that Connery was brandishing in his face like a weapon. He smiled quietly to himself. He had become accustomed to the explosive nature of his superior's temper. Connery's tantrums, he knew by experience, were short-lived. They were usually followed by affable apologies.

"What story are you referring to, Mr. Connery?" Orr asked mildly, pretending ignorance. "Perhaps, if you know the facts . . ."

"You know what I mean—this awful mockery of honest journalism—this article headlined 'WORLD'S MOST REVOLUTIONARY INVENTION. ELECTRIC LIGHT IS BORN. GLASS BULB TURNS NIGHT INTO DAY!' What perfidious reporter fell for such a hoax?"

"Marshall Fox. As you know, he is our best man."

"Doesn't he know such a light is impossible? The world's greatest scientists have demonstrated that it is against the

laws of nature. How could a man with Fox's experience allow himself to be so deceived? What will our readers think?"

"If you will allow me to explain, Mr. Connery, perhaps you won't feel that we've fallen for a gold brick," Orr replied in a mollifying tone. "Fox has written several stories about Edison's work. He did that one about the phonograph and, about a year ago, the piece about some gadget that measures the heat of the solar rays that you liked so much."

"Yes, I remember," Connery interjected, with less asperity in his voice. "But I think he's been duped about this fantastic claim that Edison has invented an electric light. Why, man, it's impossible. The biggest scientists in the world . . ."

"I've read what they had to say," Orr cut in firmly, "and they were mistaken. Fox has gotten to know Edison quite well. The inventor personally invited Fox to visit Menlo Park. He showed Fox dozens of different electric lamps he had made in recent months. Mr. Edison personally assured Fox that his newest lamp will burn steadily for more than 200 hours. It uses a cardboard filament . . ."

"Cardboard! You mean a piece of paper will burn for 200 hours? Have you lost your mind? Oh, what is James Gordon Bennett going to say when he hears about this?"

"He'll probably be proud, as I am, that the *Herald* has scored the biggest newspaper scoop in history. I think you should write Mr. Edison a grateful note thanking him for his cooperation."

"I shall fire Fox. And you, too, Orr, if this turns out to be a fake," Connery retorted grimly. "I want to see Fox the minute he comes in."

"I'll send him in to you."

Much of Connery's fury had spent itself before Fox appeared at his desk. He had put the interval to good use. He had read, and re-read the story about the electric light in

detail—something he had failed to do when the newspaper had first come to his desk and its sensational headline had sent him hurtling to the city editor. As he carefully studied the thoroughly detailed history of the invention of the electric light, his doubts began to evaporate. He gloried in the *Herald's* achievement in being the first to tell the world about the great event. What did his rival editors in the other newspaper offices think about the *Herald*, now, he wondered. He sought to hide his feeling of happy self-congratulation when he saw Marshall Fox.

"Young man," he said sternly, "are you sure you have not been made a fool's victim? This electric light yarn sounds very fishy, very fishy, to me!"

"I am positive it's quite accurate," Fox replied without hesitation. "I spent two weeks in Menlo Park with Mr. Edison watching him work and studying all that he had done. I don't blame you for being skeptical. I couldn't believe it myself at first. Not until I saw for myself. Then I had to believe my own eyes."

"Hrmph! I don't know what I'm going to tell Mr. Bennett. You know how high and mighty the publisher is. Nothing but the strictest truth must appear in the *Herald*. He'll have your head, mark my words, and mine, too, if you've been hoodwinked."

"I haven't the slightest fear for my head on that score," Fox replied with a grin. "By the way, I told Mr. Edison that a great many people would think the electric light a tall story until they could see it for themselves."

"What did he say?"

"Oh, he just laughed. He has a fine sense of humor. Then he said, 'I'll tell you what we'll do, Fox. We'll throw a party. On New Year's Eve. The most unusual New Year's Eve party anyone has ever seen. And anyone who wants to can come to

Menlo Park and see the electric light for himself.' That's a week from Wednesday. Perhaps you would like to run down with me and take a look if Mrs. Connerly hasn't made some special holiday arrangements."

"Mrs. Connerly's arrangements can wait. Nothing can be so special as this. Young man, do you realize that the electric light is one of the most revolutionary inventions ever made? It will be a great boon to all mankind. It will create new industries. It will transform our cities. It will change all our lives."

"Yes, sir, I guess you're right," Fox said mildly.

"Hrmmph! We'll go down together next Wednesday. You might stop at the house on your way and we'll have some of Mrs. Connerly's sherry first."

The New Year's Eve that ushered in the year 1870 was a memorable occasion for many others besides Connerly and Fox. Thousands of persons from both New York and Philadelphia availed themselves of Edison's invitation to spend it at Menlo Park. They forsook log fires and the traditional festivities that marked the dawn of a new year to attend, instead, the inventor's unique celebration. The Pennsylvania Railroad transported more than 3,000 visitors on special trains. Many farmers and their families arrived in old-fashioned hay wagons. Handsome carriages brought wealthy men and women whose curiosity was no less keen.

A fluffy, light snow began falling during the afternoon. Edison had planned his celebration to begin after dark. When the throngs got off the trains a beautiful sight greeted them. Hundreds of lamps had been strung along two wires extending through the leafless trees that bordered the road leading from the station to the laboratory. As the first train pulled in, Edison signalled to one of his engineers to switch on the current. The blackness of the night suddenly vanished. Each

lamp became a miniature sun. The background of snow enhanced the beauty of the golden illumination.

"Marvelous," exclaimed the delighted Connery, as he clutched Fox's arm with enthusiasm. "Never saw anything so beautiful in my life. It's like a scene from fairyland."

Then the managing editor of the Herald turned to his other companion. For Mrs. Connery, in a blue velvet gown, had insisted on making the trip, too.

"Well, my dear, don't you think this is better than dragging me to that stuffy party the Ira Birds are giving?"

"It's fascinating!" she replied. "Everyone is so well dressed it reminds me of the Easter parade on Fifth Avenue. That is, everyone except that young man over there. He looks like a tramp. I wonder why Mr. Edison let him in here?"

Connery and Fox looked in the direction to which she had pointed with her bright blue umbrella. A young man in his early thirties stood watching a dynamo as it went about its business of converting mechanical power into electric current for the lamps. He wore an old gray shirt and coarse flannels. There were acid holes in his coat and chalk marks on his trousers. A faded, wide-brimmed slouch hat perched precariously on the back of his head. The young man in the rough working clothes seemed unconcerned over his obvious poverty amid this gorgeous pageant of well-groomed men in silk top hats, and pretty ladies in Parisian lace and ribbon bonnets. Suddenly, he darted to the dynamo and bent over to tighten a copper wire.

"Oh, he must be one of Mr. Edison's engineers," Connery, who had been watching the young man with curiosity, observed knowingly.

"Yes, he is," Fox remarked with a laugh. "In fact, that's the best engineer Edison has working for him. That's Edison himself. Let's go over and I'll introduce you!"

The inventor shook hands cordially with his guests. He beckoned an assistant to take his post near the dynamo. Then he escorted them into the laboratory where still other lamps were being demonstrated to eager visitors by his aides.

An assistant placed a lamp in a jar of water. Then he turned it upside down. No matter in what position it was put, the lamp burned as brilliantly as before. Edison picked up a lamp



and showed how it could be turned on and off as rapidly as the fingers could manipulate the screw.

Bachelor hurried to the side of the inventor and spoke to him in a low tone for a moment or two.

"Oh, escort them down to the railroad station and let them go," advised Edison. "In a crowd as large as this, I suppose one must always find some people like that."

The inventor turned to Fox and the Connerys and explained, "Some of my men have caught a stranger who was trying to short-circuit the main lines leading to the lamps you saw strung along the road with a copper wire. Some of our lamps have disappeared, also. A few of them were found bulging in the pockets of another of our visitors."

"You should have the police arrest them," Mrs. Connery put in severely.

"Oh, what's the use," the inventor rejoined amiably. "Besides, pretty soon we expect to be able to make lamps by the thousands. Just as soon as we find the kind of filament I want."

"I thought you had already done that with the carbon filament," Mr. Connery said with surprise.

"We know that a carbonized filament is what we want," Edison explained. "We discovered that last October when we got a carbonized cotton thread to burn steadily for forty-five hours. But the question we have yet to solve is just what kind of carbon do we want? We have been testing everything in sight, woodsplints, plumbago, linen threads, different kinds of grasses and even hairs from red-bearded men. So far we have found cardboard filaments best."

"Are they much of an improvement over your cotton thread filaments, Mr. Edison?" Fox asked.

"Yes, they are," the inventor said. "The newest lamps we've made have a resistance of 300 ohms. When we started the best we could get was four ohms. I think our new lamps will burn at least 600 hours. So you see we are making progress."

A feminine shriek nearby drew Edison and his friends to a small building adjoining the main laboratory. A horrified, elegantly dressed lady was clutching her hair, which fell in waves about her shoulders. Her magnificent coiffure had disappeared. Her hauteur had disintegrated with it.

The inventor took the situation in with a glance. He

walked to a desk, drew open a drawer and picking up a pretty kerchief presented it to the fashionably-dressed lady in distress.

"I'm sorry, Madame, about your hairpins," he said. "But this kerchief may make a satisfactory headdress. It was made in Japan and I'm sure it will look very well on so handsome a head!"

The gift was accepted graciously. Edison returned with a smile to where Mrs. Connery, in particular, had been watching the mystifying scene with baffled amazement.

"What on earth happened to that poor woman?" she asked.

"She neglected to take those big signs seriously," Edison explained. He pointed to several huge posters warning visitors with watches and hairpins on their persons not to enter that particular room. "The generators magnetized her hairpins and pulled them right out of her hair!"

Connery and Fox burst into laughter. "If Mrs. Connery were not here," the managing editor observed slyly, "I might say that we have just witnessed a lesson in the value of simple hairdresses—and hats." Mrs. Connery merely snorted. Mr. Edison smiled in quiet amusement but said nothing.

As the time approached for their return trip to New York, the Connerys and Fox bade the inventor farewell.

"When are you planning to put your wonderful lamps on the market?" the managing editor inquired in parting.

"Some of our people want me to do that now, but I'm against it," Edison said thoughtfully. "But as soon as we have the lamp I want, one that will burn for 1,500 hours and will not cost more than fifty cents, the public is welcome to it. Of course, we cannot supply electric lighting in New York without building a special central station for generating electricity. That will take some time and will cost a great deal of money."

"Do you think electric lighting will ever be as cheap as gas?" Mrs. Connery asked timidly.

"I suppose that question would appeal to a woman above all," the inventor replied with a twinkle in his gray-blue eyes. "Electric lighting now is already as inexpensive as gas illumination. And when we have the kind of filament I am looking for we shall be able to make a longer lasting lamp that will need a smaller consumption of current. Then electric lighting will be so much better and cheaper than gas that we shall put the gas people completely out of business."

"Precisely," exclaimed Mr. Connery enthusiastically. "That's just what I told Fox when I read his story about the lamp. Revolutionary, I said. It will transform our civilization. It will change everyone's mode of living. You have made the world a different place in which to live, Mr. Edison. A better and happier as well as a brighter place. It's been a pleasure to meet you, sir. Remember when you are ready we want the Herald to be one of the first to install your system. Good-bye!"

The spectacular success of the New Year's Eve demonstration of the incandescent electric light by Edison created tremendous excitement throughout the world. Laudatory telegrams and cables poured into Menlo Park from all corners of the globe. Edison became the subject of fabulous legends and myths. The public, in a mood for hero-worship, was ready to believe that the inventor was a "wizard" who was capable of anything!

A fantastic story circulated by a fanciful writer in a burst of ill-advised humor gained wide credence.

"What everyone thinks is the evening star is really an electric lamp that Edison sends up attached to a balloon every night," the writer solemnly reported.

Incredibly, thousands of people accepted the humorous

story as fact. The heavenly luminary became known as the "Edison star." The Edison laboratory was deluged with letters from all parts of the country. The writers proudly explained that they, too, had seen Edison's mysterious lamp in the night skies and would the inventor please tell them what it was up there for? How was the light suspended? What was the inventor's object in sending it up to such a height?

At first Edison merely laughed. But as the letters continued to pour in, he became seriously annoyed. He asked Marshall Fox to assure the public through the pages of *The Herald* that the so-called "Edison star" was a hoax—that God alone was responsible for the stars in the universe. Despite these denials, the legend of the "Edison Star" persisted for many years. Inquiring letters did not completely cease until the Spanish-American War.

Even more annoying to Edison was another fake story. A writer for a "yellow" journal visited Menlo Park to interview the inventor. But Edison would not see him. None of Edison's associates had any information of the "startling" nature that the visitor craved. The aggrieved journalist returned to New York City, sat down at his typewriter and fabricated a story.

"Thomas Alva Edison, the magician of Menlo Park, who has given the world the electric lamp, will soon give mankind another boon," he trumpeted. "It is an ingenious shirt that will last any man for twelve months or longer with care.

"The front of this magnificent shirt consists of 365 very thin layers of certain fibrous material chemically treated according to a mysterious formula devised by the famous inventor. Each morning, the fortunate owner of this wonderful shirt can have a spotlessly white garment by simply tearing off one of the 365 layers. Edison himself is wearing one of these shirts. It is by far the most wonderful invention that has come out of his laboratory!"

The deception was printed in more than 500 newspapers throughout the United States. Again Menlo Park was deluged with inquiries. Many of the letters were accompanied with orders for anywhere from one to one hundred "Edison shirts." The story spread to other countries. Chinamen, New Zealanders, Egyptians and staid Englishmen also hankered for the new garment that Edison was supposed to have created. The shirt, they agreed, was "a grand idea." Many of these messages enclosed checks and currency. These had to be returned with a letter explaining that the "Edison shirt" was a product of a practical joker's imagination.

"If I could get my hands on the foolish young man who made up that story, he wouldn't want a shirt or anything else on his back for a few weeks," Edison angrily promised.

Meanwhile, Edison had obtained a patent on his incandescent lamp on January 28, 1880. This was the first of 169 patents on electric lights that he was to take out during the next few months. His hunt for a filament that would make possible the development of the fullest power of his lamp was also making progress.

Rags and textiles steeped in chemical solutions, innumerable species of wood, the skins of snakes living in steaming jungles and the shiny furs of the animals of the frozen north, vegetables, minerals and grasses—all were carbonized and tested in an incandescent lamp. The results varied. The whitest and brightest light using the least amount of electric current was obtained from specimens belonging to the grass family.

As Edison pondered over these tests with grasses, he suddenly recalled with a chuckle the amusing incident of the fashionable lady who had lost her hairpins to his magneto-charged generators. He had given her a Japanese kerchief as a consolation, he mused, and that kerchief had come to him

with a bamboo fan as a gift from an admirer. Bamboo, he reminded himself, was an outstanding example of the world of grass plants.

The inventor went hunting eagerly for the gayly-colored fan.

"Batch," he asked, "have you seen that Japanese bamboo fan someone sent us at Christmastime?"

"I think I saw Kruesi with it the other day, chief. He was using it, I believe, to help along the evaporation of some solutions he was working with. I'll go look."

"I'll come with you, Batch. I'm anxious to try out a piece of that bamboo as a filament. I've got a hunch that it might prove to be what we've been searching for so hard."

The Japanese bamboo fan was found in a corner of the laboratory near a pile of glass bulbs and chemical solutions. Edison picked it up and examined it closely. Then he ripped off a piece of the tough rim that surrounded the leaf of the fan and held it in shape.

"Here, Batch, whittle this down and let's try it in a lamp," he ordered.

Edison put down one word in his notebook after the bamboo test—"Excellent." Then he immediately started out to learn everything there was to learn about bamboo. He discovered that there were twelve hundred varieties of bamboo known. So he organized expeditions to journey to every corner of the world to obtain a specimen of each variety. He wanted the most homogeneous kind of bamboo that grew anywhere.

It cost him \$100,000 to satisfy that wish. Men were dispatched to the interior of Japan, to the Malayan Peninsula, Mongolia, Burma, the lair of the tigers of India, up the alligator-infested Amazon and its little-known tributaries, to Patagonia, to malaria-ridden Ceylon, Mexico and Sumatra. Bamboo specimens in large bales pasted with foreign labels began arriving in the Menlo Park laboratory. People all over the

world heard that Edison was looking for bamboo and joined in the hunt. Some of Edison's investigators traveled as much as 30,000 miles, eluded wild animals, fought venomous reptiles, penetrated jungles and swamps, surmounted fevers and other dangers to get the inventor what he wanted. Some never returned from their dangerous mission.

More than 6,000 specimens of bamboo reached Edison. The inventor had each one carbonized in his muffle furnace and tested in a lamp. Of these, three species that were found in the valley of the Amazon gave almost perfect results. The electric lamp was ready to light the world!

A long time afterward, after many years of research, Edison was to develop an artificial filament manufactured from a cellulose mixture in the laboratory that was to prove even better than bamboo. But until then, bamboo furnished the filament for millions of electric bulbs. Special farms were created in Japan to raise the right kind of bamboo. When Edison could not get the support of financiers to erect a factory to make his new lamps, he decided to produce them himself.

He converted one of the old Menlo Park buildings formerly used in the manufacture of the electric pen to his purpose. He offered to supply the new lamps at forty cents each.

That was a rash promise. The lamps cost him \$1.25 to manufacture. The demand for the lamp was enormous. Edison moved the factory for its manufacture from Menlo Park to Harrison, New Jersey, and placed it on a profit-sharing basis. He issued 100 shares at a par value of \$100 a share. Most of his associates became partners in the new enterprise.

During the second year of the lamp factory's operation, Edison managed to reduce the cost of each lamp to seventy cents. The third year the cost dropped to fifty cents, still ten cents more than the sale price. Edison's losses were piling up

like a mountain, threatening to engulf all his work in disastrous bankruptcy.

He then concentrated his research to improve the machinery and materials of production. The cost of the lamp dropped steadily to twenty-two cents four years after the lamp factory had started. The profits in a single year were enough to wipe out the deficits of the four previous years. A group of Wall Street bankers begged Edison to sell them the lamp factory whose erection they had disdained to finance.

The Harrison factory, which had begun with a capitalization of \$10,000, was purchased by Wall Street for \$1,085,000. Edison's associates who had joined in the partnership to create the lamp factory felt as if Santa Claus had made them suddenly rich! The inventor used his newly found affluence to pay off all his accumulated debts and to finance some new dreams of his ever-dreaming and restless mind.

Chapter Ten

THE ELECTRICAL AGE IS BORN

“COME ON, Batch, pack up!” Edison called out jubilantly. “You’re coming with me to New York. We’re going into business in a big way.”

Twelve years after he had landed in New York City from a Boston boat, a penniless and hungry telegraph operator who was obliged to depend on the chance bounty of a tea merchant for a skimpy breakfast, Thomas Edison returned to “the big city.” He was now thirty-two years old and world-famous. This time he arrived in New York as another Alexander who sought new worlds to conquer.

Having invented the electric lamp, he wanted to install it in every home, in every factory, in every business house. But in 1881 the art of electricity was still in its swaddling clothes. In this diaper stage of electric light and electric power there were no factories to make the various accessories needed to make electric lighting available to the residents of a big city. Indeed, for the most part, the accessories themselves did not exist. They had to be invented. Then factories had to be set up for their manufacture. Unskilled men had to be trained in the new art before the electrical age could be born.

Edison calmly tackled this gigantic task from a four-story brownstone building located at 65 Fifth Avenue. The handsome mansion had been the fashionable home of a railroad executive. The inventor converted it into headquarters for the various Edison companies. The first floor included a reception parlor and private sanctum in the rear for Edison. There were

offices for such departments as engineering, drafting, house installation, street installation, legal affairs, bookkeeping and manufacturing on the second floor. The third floor contained living quarters and the fourth a library. Edison also acquired a secretary. His name was Samuel Insull, an Englishman who was destined to have a turbulent career as a utility magnate many years later.

It was from this modest building that Edison began to plan the lighting of a whole district in New York City for the first time. It was here that such titans of the modern industrial world as the General Electric Company, the New York Edison Company and the Consolidated Edison Company were born.

The one-time train boy began to establish factories to make parts for his electric lighting system wherever he could find a suitable vacant property. He took over the old Etna Iron Works on Goerck Street on the East Side of the city. He set up the Edison Machine Works there. This was Edison's first factory for dynamos. Sigmund Bergmann, a former Edison employee who was to become the head of a great electrical industry in Berlin years later, was put at the head of an establishment in Wooster Street to make meters, fuses, cutouts, chandeliers, sockets and switches. John Kruesi became the manager of the Edison Electric Tube Company at 65 Washington Street. Here Edison manufactured underground tube conductors and junction boxes. At 257 Pearl Street was established the Pearl Street Central Station, the pioneer of thousands of similar stations now scattered throughout the world to generate and distribute electric power.

Many of the products made in the various Edison factories were created by the youthful inventor. As endless work piled up ahead of him, the harassed midwife of the birth of the age of electricity complained to Batchelor that there "was nothing

that we can buy or that anybody else can make for us. We must build everything with our own hands!" He obtained more than 300 patents within a short time to cover a multitude of inventions that he devised to create and perfect his system.

Nearly 2,000 employees were now working for Edison. Many of them had come fresh from college campuses, imbued with a love for established rules and the scientific approach to all problems. Edison, uninhibited by any formal education to speak of, preferred to rely on common sense. He believed in the trial and error approach to the job ahead. At first, some of the collegians, crammed with book learning, thought they had an advantage over their employer, whose schooling had been limited to a bare three months. But they soon learned to respect and admire the untutored inventor's uncanny grasp of the fundamentals of any problem.

Edison one day approached a newcomer from Princeton who had been assigned to draft a method of winding the armature of a generator.

"How's that armature job coming along, Upton?" he asked.

Upton pointed to a sheaf of drawings and said, "I expect to have it ready for you in another week, Mr. Edison."

"Hmml!" commented Edison. "I think we can hurry up the job somewhat. Why don't you have Kruesi make up a few small wooden models? Then instead of drawing imaginary lines on pieces of paper you can take a few pieces of string and actually wind them around the block."

"But that wouldn't be scientific," Upton exclaimed in a horrified voice.

"What do you care," retorted Edison, "if it does the work we want it to do?"

Upton followed Edison's suggestion. It proved to be a time-saving shortcut to the solution of his problem. The design for

the armature was ready the next day, instead of a week later!

On another occasion, Edison asked a mathematician to compute the cubical content of a bulb. Several days elapsed. Wondering what was delaying the information he wanted, Edison sought out the mathematician.

"I suppose you've forgotten about that bulb I wanted measured," he said mildly.



"Oh, no, Mr. Edison, I haven't forgotten," the young mathematician protested. "I've been working on it steadily for three days." Then, pointing to a thick pile of charts and figures on his desk, he added, "I hope to have the result ready for you by the end of the week."

"Let me show you how to do it in a few minutes," Edison

said patiently. He picked up the bulb and poured water into it. "Now measure the water," he advised, "and you'll have the answer!"

Meanwhile, James Gordon Bennett, owner and publisher of the *Herald*, had become as enthusiastic a champion of Edison's electric light system as his managing editor, Thomas Connery. The enterprising publisher had arranged to send the sailing vessel *Jeannette* to the North Pole. Edison was asked to install a complete electric light and power system on the vessel. He did, to the great delight of Bennett and of the crew that was to invade the frozen northern wilderness. Unfortunately, the *Jeannette* was caught in an ice pack off New Siberia Island and never returned from its hazardous mission.

The first large steamship to be outfitted with electric lighting was the *Columbia*. A new ship, the *Columbia* was the finest steamer yet built and was scheduled to run between New York and San Francisco as the flagship of the Northern Pacific lines. Marine underwriters refused to insure the vessel. They predicted that it would burn up before completing its maiden voyage.

However, Henry Villard of the Northern Pacific had unbounded faith in Edison's genius. The railroad magnate and the inventor became fast friends as Edison hustled to outfit the ship in time. Then a large part of New York's population thronged to the *Columbia* to see the "miracle" of the gayly lighted ship for themselves. Two days later the *Columbia* nosed out of her North River pier and began steaming for Cape Horn. Seven weeks later a happy message signed by Henry Villard in San Francisco arrived at 65 Fifth Avenue. It read:

COLUMBIA ARRIVED HERE TODAY COMPLETING MAIDEN
VOYAGE WITHOUT INCIDENT STOP YOUR GENERATORS AND

ELECTRIC LAMPS WORKED PERFECTLY DURING VOYAGE
STOP EVERYONE PLEASED AND AMAZED STOP ALL SAN
FRANCISCO AT DOCK TO SEE SHIP STOP CONGRATULATIONS
AND BEST OF LUCK.

New Yorkers had another thrill when Edison, conscious of the value of the spectacular to break down public fears and prejudice against "the newfangled electric light," staged a parade. Several hundred men moved down Fifth Avenue in the form of a hollow square. Each wore a helmet. Each helmet was surmounted by a little electric lamp. Inside the hollow was a portable steam engine and an Edison dynamo. The marchers carried a long rope containing a conductor which was attached to the dynamo. Flexible wires passed from the conductor through the sleeves of the paraders to the lamps on their hats. A marshal led the march on a magnificent white horse. He carried a gleaming baton, also tipped with a lamp. Upon a signal from the marshal, all the lamps, drawing current from the dynamo, suddenly flashed on. Another signal, and the lamps became dark again. The crowds enjoyed the show immensely.

Edison became a stage manager in a real theatre when the enterprising owner of Niblo's Garden decided to put on "the great Mimical Dramatic Ballet Spectacle Excelsior." He equipped each of the girls in the ballet with an electric light on her forehead. Each girl also carried a wand with a lamp at the tip. Each lamp was connected by carefully hidden wires, with the dynamo that Edison had built in the basement. The performance hit a climax when, at a given signal, the girls in the ballet flashed on four hundred lamps in a dazzling display. Advertised as offering "novel lighting effects by the Edison Electric Light Company, under the personal direction of Mr.

Thomas Edison," the spectacle was the sensation of the city's theatrical season.

The Governor of Massachusetts and the Mayor of Boston attended with their staffs when the first American theatre boasting a permanent electric light system was opened in Boston. Edison had personally supervised every detail of the installation and had every expectation of complete success. But a sleepy fireman almost ruined his plans.

The performance selected for the gala occasion was Gilbert and Sullivan's "Iolanthe." Everything was going along nicely. Mary Edison, who made a striking appearance in a new white satin gown, had accompanied her husband and was enjoying the experience hugely. She leaned over to comment about the beauty of one of the spectacular scenes when Edison noticed with dismay that the electric lights were gradually growing dimmer. He excused himself with a quick whisper and hurried to the power plant. He discovered that the fireman was taking a nap and had allowed the steam to get dangerously low. He shed his coat, rolled up his sleeves and began furiously to pile coal onto the dwindling flames. When the steam reached the level to maintain electric power, Edison donned his dust-covered coat, admonished the fireman and returned to his seat. Mary Edison quietly brushed off some of the dust on his coat with her gloved hands. Then the two sat back uninterruptedly to enjoy the closing scenes of the fairy operetta.

During all this time, Edison had been pushing ahead with the most ambitious project he had ever planned. He wanted to give the electric light to New York. He had such sublime faith in his invention that he did not for a moment doubt his capacity to overcome the tremendous obstacles ahead and to be the first man to bring electric lighting to a big city. He called the erection of the Pearl Street central station and the

distribution of electric lighting from it to lower New York "the greatest adventure of my life."

"It was akin to venturing on an uncharted sea," he never tired of recalling. "No precedents were available. I felt the sense of a great responsibility, for unknown things might happen on turning a mighty power loose under the streets and in the buildings of lower New York. However, I kept my own counsel."

Application for a franchise to lay pipes in the city's streets had been filed shortly after the move to 65 Fifth Avenue. But the city authorities delayed action. The rich gas corporations organized a powerful lobby to fight the Edison interests. Moreover, a large part of the public was still fearful of electric lighting. They fell easy prey to the propaganda of the gas companies that Edison's plan to install electric wires under the city would blow up the city! Edison challenged the pessimists and the critics by making a sensational offer that won him new friends.

"Anyone who thinks my electric light is a danger to the city and to its citizens is welcome to visit Menlo Park and to burn down my laboratory as it stands, provided he can do it with the electric light," he said in his defiance. "I shall be glad to personally escort him. I am sure that any fair-minded person will agree after any reasonable test that the electric light is safer than gas lighting or any other type of illumination."

The inventor invited the city's Board of Aldermen to Menlo Park as his guests. For their benefit, he repeated the wonderful spectacle he had first staged on New Year's Eve following the publication of the *Herald* story. The aldermen reached Menlo Park after night to find the railroad station, the path to the laboratory, the laboratory and every other building in Menlo Park aglow with Edison's newest lamps. The dazzled officials eulogized the embarrassed Edison as "the greatest American

inventor." They feasted at a special supper with champagne that had been ordered from Delmonico's. Upon their return to New York, they voted enthusiastically to approve Edison's application for a franchise.

The Mayor of the City of New York, however, refused to sign the franchise. Although no tax was levied against gas pipes, he proposed that a charge of \$1,000 be made for each mile of electric wires installed in the streets. Once again, the harried inventor was forced to wage a stubborn battle against the enemies who sought to defeat him. Fortunately, the aldermen remained his friends. After several months of vigorous debate they passed his application over the Mayor's veto.

Politics had been blasted from his path. But another obstacle remained before Edison could proceed with his great design.

Two depressions had hit the country within a period of five years and these had added to the natural caution of conservatism of the bankers. In creating his various factories for making the parts that he needed to install an electric light system, Edison had been forced to rely on his own financial resources. He had borrowed from his generous friends. But now he had reached the limit of his own resources. He had to have outside help. Lighting New York was a gigantic undertaking. It required a large fortune to finance it. Only the bankers could extend that kind of credit. The inventor called a group of Wall Street financiers into consultation to renew his pleas for credit.

"Young man, don't you think you are going ahead too fast?" a spokesman for the guardians of the cashbox said. "What you propose to do has never been attempted before. If you fail, we lose a million dollars. Frankly, such a huge loss, so soon after a depression, would ruin us!"

"I will not fail," Edison exclaimed confidently. "I might

recall that when we wanted to build a new lamp factory in Harrison we heard the same story from Wall Street. That lamp factory is the property today of bankers who paid more than a million dollars for it. They could have had it for a small fraction of that sum if they had been agreeable to advancing us the credit we wanted at the beginning. What I am offering you gentlemen is the opportunity to make another fortune!"



A rotund, elderly banker with handsome sideburns and a Van Dyke beard smiled ruefully as the youthful inventor spoke. He had been one of those who had rejected Edison's plea for a loan to build the lamp factory. He did not want to repeat the error of timidity.

"We want to help you, Mr. Edison," he said slowly in a stentorian voice. "But we believe it is in your own interest as well as ours not to proceed rashly. The gas companies are strongly entrenched. They will fight fiercely to protect their

investments. You say your system will provide electric lighting more cheaply than gas. But how do you know?"

"I can prove it," Edison replied triumphantly. "I anticipated your question. I have here an insurance map of New York showing every elevator shaft and boiler and housetop and fire-wall. I hired a man to start in every day about two o'clock and walk around through the district we mean to serve and note the number of gas lights burning in the various premises. He went around again at three o'clock and made more notes. He returned at four o'clock and up to every other hour to three o'clock in the morning. In that way, we have determined exactly the gas consumption of every tenant and of the whole district."

The bankers were deeply impressed. Prudence, however, dictated one final question.

"And you are sure, Mr. Edison," the banker with the sideburns asked, "that you can provide electric lights for the same period of time at no higher cost?"

"Gentlemen, just wait a little while," Edison put in with mounting enthusiasm, "and we'll make electric lighting in New York so cheap that only the richest bankers can afford to use gas or candles!"

Edison's visitors laughed good-naturedly in appreciation of his witticism. They agreed to organize a corporation with a capitalization of \$1,000,000 for "the distribution of light, heat and power" in New York City. It was named "The Edison Electric Illuminating Company of New York"—the parent of the giant multimillion-dollar utility of today, The Consolidated Edison Company.

Edison summoned his lieutenants. To each he issued a special set of instructions. His buoyant enthusiasm was contagious.

"Men, we have finally won over both the politicians and the

bankers," he told them in a jubilant voice. "But we have a big job ahead. It's the biggest job we have ever tackled. There will be many difficulties. If we let them defeat us, we will be ruined. We will also be the laughingstock of the world. But I am sure we will win out. When we have succeeded in lighting lower New York for the first time with electricity we shall have done something in this world no one before us has ever done.

"As you know, our plans call for providing light in this area"—Edison pointed to the same insurance map of lower New York that he had shown to the bankers—"from just south of Wall Street up to Canal Street and over from Broadway to the East River. We shall have to lay eighteen miles of mains. We'll start at Peck Slip, go up Ferry Street, through Spruce and along William to Beekman."

Various crews were organized, each under a trusted lieutenant. Some dug the trenches for the underground conductors. Others wired the business buildings and the homes whose owners had agreed to install electric lighting. The Fifth Avenue headquarters became a training school for new workmen. Students were taught the basic principles of the Edison system. They were shown how to connect dynamos and how to lead the wires from the underground conductors to the electric lamps.

Edison himself supervised every detail of the giant undertaking. His men spoke of him as "tireless as the tides." He spent much of his time with the laborers in the trenches. He saw every box poured and every connection made in the whole underground system. He snatched a few hours of sleep each night by lying down over the hard iron tubing in the cellar of the Pearl Street central station. When two German workmen contracted diphtheria in the damp basement and died, the inventor's aides remonstrated with him.

"Chief, you must take better care of yourself," they pleaded. "If you were to fall ill it would jeopardize the whole undertaking."

"Yes, it would," Edison agreed. Then he smiled and added firmly, "But I don't intend to be sick. I feel fine. A few hours' sleep is all I need and someone must be around all the time to superintend this job. If I don't do it, who else could? Besides, I want to get this work finished by Fall. Some of our banker friends are getting jittery about all the money we are spending. I want to keep them quiet by showing them some practical results as quickly as possible."

By driving his crews night and day, Edison was able to lay his mains at the rate of 1,000 feet a day. He invented a safety device to eliminate the hazard of fires caused by overloading the cables with current. He inserted a zinc connection at regular intervals along the cables. He called this "a weak point" because it was weaker than the cable in its resistance to electricity. An overload of current would thus burn it away and shut off the flow of electricity by breaking the circuit.

Edison's prediction that he would be ready to light lower New York by Fall proved to be too enthusiastic. Iron manufacturers were too slow in delivering the pipes he needed for underground mains. Sometimes the "home-made" equipment used in the installation proved faulty. Thus, one day, a nervous assistant rushed to Edison and in an excited voice urged him to hurry to Fulton Street.

"Kruesi says he needs you right away," the young man cried. "The pavement has become electrified and the horses are dancing in the streets!"

Edison dashed to Fulton Street to investigate. The strange report was true. A leak from several underground conductors had electrified some spots in the street and horses setting hoofs on such places received a galvanic shock. Several days

were required to locate the faulty conductors and to replace them.

Such vexatious delays saw the onset of Winter and the ground frozen before the last of the eighteen miles of mains could be laid. The work had to be stopped to await the thaws of Spring. By the middle of the following Summer, all the mains were in place, 900 buildings had been wired, more than 14,000 incandescent lamps put in their sockets and meters installed. Since no meters existed, Edison had invented one. He contrived a glass cell containing a solution in which two zinc plates were immersed. When electricity passed through this device, it created an electroplating action. Zinc was deposited on one plate from the other. By measuring the amount of zinc deposited in this way, the Edison meter was able to show just how much current had been consumed.

As the anxiously awaited day when the world would learn whether Edison's "greatest adventure" was a glorious success or a disheartening failure approached, the worried inventor received a cheering message from Washington. It was from the head of the Patent Office.

"I have the pleasure to inform you," the heart-warming letter read, "that our staff, which has been kept so busy by you in the past, and, we trust, will be equally active due to your efforts in the future, has approved all of your recent applications. We are issuing you today thirty-one patents. That is, according to our records, by far the largest number of patents ever issued by this office to one man at one time!"

Among the new patents were several dealing with a new dynamo Edison had devised. The tireless inventor wanted a monster generating machine for his central station in Pearl Street. He knew that he would need a great deal of electric current to meet the demands of the square mile of territory in lower New York that he had undertaken to supply. No dy-

namo then existed that was capable of the task. Edison called in Charles T. Porter, an eminent engineer.

"We must have some high-speed engines," Edison said. "The machines that we now have with their capacity for sixty revolutions per minute are too weak. I want a 150-horsepower engine that can run at a speed of 700 revolutions per minute."

"Impossible!" exclaimed Porter. "No machine approaching such power and speed has ever been made."

"That's no reason why it can't be done," the inventor cut in impatiently. "Let me explain how you can do it. The slow-speed engines that we have been using drive the dynamos through a complicated system of belting and shafting. That is inefficient. Much of the power generated is lost. I want a large-capacity unit without the superfluous belting. I want you to make an engine like this"—Edison displayed a rude drawing he had sketched of his idea—"a direct-coupled machine. A dynamo hitched directly to the engine will give us the speed and power we must have!"

The first jumbo electric generator was built in the Edison Machine Works a few months before the fateful September day on which Edison was to pull the switch that was to pour electricity through the eighteen miles of mains under the streets of the nation's greatest city. It was a colossus that made even Edison's aides, long accustomed to the wonders produced by their chief, stop and stare with open mouths. It weighed twenty-eight tons. Its first test indicated the need of some adjustments. Edison made them. Thereafter the engine ran for eight years without a pause!

Edison set Monday, September 4, 1882, as the day when the lights would be turned on in New York. He spent the Sunday before checking over details of his installations. He found everything in order. But the knowledge of the great issues at stake made him apprehensive. All the equipment

installed in office buildings and homes had been at the expense of the Edison company.

"You will owe us nothing," subscribers had been promised, "if the electric lighting system does not work satisfactorily. You will be obligated to pay only if the lights work well and at a cost lower than that of gas!"

The tremendous responsibility hanging on his shoulders caused the nervous inventor to spend a sleepless night. He devoted Sunday night and early Monday morning in studying once again every minute detail of the power plant in Pearl Street. Then he went home and dressed in a frock coat and striped trousers, as a concession to the historic occasion. At three o'clock that afternoon he was in the Drexel and Morgan offices to turn on the lights, while J. P. Morgan and the other bankers who had agreed to back him anxiously awaited the results.

"Edison was vindicated last night and his light triumphed again," the inventor's friend, Marshall Fox, wrote in the Tuesday morning edition of the *Herald*. "The inventor confessed that he was a bit nervous before the test, as indeed any human being would have been who had tackled so gigantic a task for the first time in the history of the human race. Fortunately, his fears were groundless.

"The thousands of electric lamps in the hundreds of buildings throughout the area burst into a bright and mellow brilliance as the switch was pulled at a signal from the famous inventor. Lo and behold, the dim flicker of gas was supplanted by a steady beam, under which one could sit down and write for hours without the consciousness of having any artificial light about him. The decision was unanimously in favor of the Edison electric light as against gas. What his critics said was impossible, the wizard of Menlo Park has made an everyday reality!"

Marshall Fox, his managing editor, Thomas Connery, and the publisher of the *Herald*, James Gordon Bennett, went hunting for Edison shortly after the lights were turned on to offer him their congratulations. The *Herald* offices were ablaze with the new illumination. The trio discovered Edison, after several hours' search, in the Pearl Street power plant. He was coatless and collarless. His shirt was black with grease and soot. He grinned sheepishly as he saw his visitors.

"I thought this engine was making too much of a racket," he explained. "I've been under it to readjust the tubing a bit to make it work more smoothly. Well, how do you like the electric lights in your place?"

"They're fine, Mr. Edison, except for one thing," Connery pointed out. "I could light my cigar with a gas light, but your newfangled lamp is no good for that purpose!"

Edison visited the *Herald* office two days later. When he departed, he left behind a small package on Connery's desk. It contained an electric cigar lighter.

Edison's success led to a spectacular rise in the shares of the Edison Electric Illuminating Company. Stock with a par value of \$100 was soon selling for \$5,000. A race began everywhere to build thousands of new electric power plants, along the lines of Edison's Pearl Street station, and to organize new electric light companies that were to amass billions of dollars in capital resources. The happy bankers who had backed Edison to found the Edison Electric Illuminating Company gained a new fortune through Edison's success in aiding human happiness and welfare. Mankind harvested a new golden age.

Chapter Eleven

RIDING ON THE BACK OF ELECTRICITY

SOON after his return from the successful maiden voyage of the *Columbia*, Henry Villard was a dinner guest at the Edison home in Menlo Park. He told the smiling inventor and his gracious wife how the Californians had flocked to the waterfront to feast their unbelieving eyes on the magical sight presented by the first steamship equipped with electric lighting.

"There hadn't been so much excitement in California since the days of the fabulous gold rush," the enterprising head of the Northern Pacific reported. "The crowds were inspired by what we had to show them and we were just as inspired by them!"

"Pretty soon they will be able to have their own electric lamps in California," the inventor declared. "Several new Edison electric companies are being organized in Detroit, Chicago, Philadelphia, Boston, St. Louis and one, I believe, in San Francisco. Perhaps the California company will vote you a bonus for the free advertising you've given them!"

Villard laughed at his friend's joke. Then, resuming a more thoughtful manner, he leaned over, helped himself to a cigar from a box that Edison held out to him, took a light from the inventor and said, "You know, Tom, I've been thinking for some time that the days of the horse cars and steam trains are just about over. Is there any reason why we couldn't run the mountain division of the Northern Pacific by electric power?"

"Not a one," the inventor replied enthusiastically. "Some

day, all transportation will move on the backs of electric engines!"

"Will you tackle the problem for us, Tom?"

"Well," hesitated Edison, "it's rather a simple matter for any engineer to take what we already have and devise a suitable system for your railroad. It's too easy for me to undertake. I'm supposed to be an inventor. Why don't you get an engineering firm to do it for you?"

"Because I want to be sure that it will work when it is finished. Many people think that electric railways are impossible."

"They don't know what they're talking about," the inventor broke in with quick protest. "It would take only a few months to design a system that would do away with horse cars and steam locomotives."

"Look at this." Henry Villard unfolded a newspaper and pointed to an item on the front page. It bore this headline:

HORSE CARS TO STAY

RAILWAY OFFICIAL SAYS

Edison read the headline and the opening paragraph of the interview that followed it. "If you want to pull a car, you must put something in front to pull it!" the pompous railway magnate had told his interviewer. "Electric transportation is absolutely and utterly impracticable."

"And you are absolutely and utterly an ignorant fool," muttered Edison, throwing the newspaper aside impatiently. "Henry, I'll build an electric railway system for you at Menlo Park!"

"That's fine, Tom. I was hoping you'd take on this job. I wouldn't trust it to anyone else. How about the expense? The Northern Pacific will underwrite the cost of the experiment."

"I'll make a bargain with you, Henry. If I succeed in building a railway system that works satisfactorily and that you can install on the Northern Pacific, then we will charge you for the costs. Otherwise, we will pay the bill. Don't you think that's a fair bargain, Mary?"

The inventor's wife, who had been quietly sipping her after-dinner coffee, gently set down her cup and furrowed her brow as if she were in deep thought.

"I daresay you won't need any referee over any agreement you make," she laughed.

The first railroad that Edison built at Menlo Park operated on a rough roadbed that rested on the natural contours of the ground. No attempt at grading had been made. Two light rails placed about three and a half feet apart formed the tracks. The first "locomotive" was a flat-car on which Edison had installed one of his "Z" type dynamos. Behind this "locomotive" were two light cars with awnings and seats for passengers. The inventor had humorously painted on the awnings this legend in large letters: "PULLMAN."

This was the first electric railroad in the United States. All of the employees in Menlo Park turned out to see its first test. The diminutive train ran merrily up and down its half-mile track, confounding the skeptics who had rashly predicted that electric traction was impossible. Crowds from everywhere thronged once again to Menlo Park to see the new wonder that the "wizard" had created. The excitement of the spectacle was heightened by the tendency of the train to jump its track occasionally, owing to the ungraded roadbed.

The inventor's legal adviser, Grosvenor P. Lowry, was among the guests who rode on the train in its first test. He reported back to his colleagues, who were eagerly awaiting at 65 Fifth Avenue news of the outcome, that the electric railway was a "huge" success. He indicated that it was per-



The train jumped the track on a sharp curve

haps even a greater success with Edison than with anyone else.

"Goddard and I have spent a part of the day at Menlo, and all is glorious," he wrote.

"I have ridden at forty miles an hour on Mr. Edison's electric railway—and we ran off the track. I protested at the rate of speed over the sharp curves, designed to show the power of the engine, but Edison said they had done it often. Finally, when the last trip was to be taken, I said I did not like it, but would go along.

"The train jumped the track on a short curve, throwing Kruesi, who was driving the engine, with his face down in the dirt, and another man in a comical somersault through some underbrush. Edison was off in a minute, jumping and laughing, and declaring it a most beautiful accident.

"Kruesi got up, his face bleeding, and a good deal shaken. I shall never forget the expression of voice and face in which he said, with some foreign accent, 'Oh, yes! Perfectly safe!' Fortunately no other hurts were suffered. In a few minutes we had the train on the track and running again."

The success of his first electric railway encouraged Edison to build a larger and better railroad. He built a longer track, about three miles in length, with grades, switches, sidings, and the other equipment of a complete railway. He designed two different kinds of electric locomotives. One, light and fast, was used for passengers. It could haul ninety passengers at a time at a speed reaching up to sixty miles an hour. The other locomotive was used for freight traffic.

Edison devised a system by which a third rail provided the electric power to drive the train. He also invented an electric braking device. His opponents immediately rushed to the attack. The third rail, they averred with more sound and fury than knowledge, would be short-circuited by the wet earth and

in any event could never produce sufficient voltage to run a giant transportation like a railway!

Edison paid no heed to his critics. He let his system speak for itself. He operated his three-mile stretch of electric railway under all sorts of conditions, in freezing cold and in humid hot weather, under snow and rain. He ran wagons over his experimental rails to prove that his system was not a death hazard and that his railway could not be short-circuited.

During these experiments, the crash of the Northern Pacific swept away Henry Villard's wealth. The railroad magnate had to begin anew to rehabilitate his personal fortune, at one time one of the greatest in the country. He insisted, however, upon reimbursing Edison for the cost of the electric railroad experiments.

"Forget it, Henry," Edison replied firmly to his friend's pleas. "The thing for you to do now is to get back on your feet again. I'll be glad to help in any way I can. As for the electric train, I've had as much fun with it as any kid with a Christmas toy. That alone was worth all the expense."

The Edison Electric Company of America was formed with an authorized capital of \$2,000,000 to exploit Edison's patents on electric railroading. But the idea of electric traction had to contend with public prejudice and the ingrained conservatism of the street car and railway officials.

The vociferous agitation of Edison's friends on the New York *Herald* and of other forward-looking people slowly won friends for the new system of transportation. The picture of weary horses jogging along between the rails, the bells on their harnesses jingling, while the swaying driver alternately flicked a whip at his horses and spat tobacco juice out of the corner of his mouth, had been a familiar one in the nation's cities for more than fifty years. Gradually it became less and less familiar as electric traction grew more popular. The day finally

arrived when Oliver Wendell Holmes could pay tribute to the electric street car in "The Broomstick Train: or The Return of the Witches."

"Look here!" he exclaimed in "Over the Teacups." "There are crowds of people whirled through our streets on these new-fashioned cars, with their witch-broomsticks overhead—if they don't come from Salem they ought to!—and not more than one in a dozen of these fishy-eyed bipeds thinks or cares a nickel's worth about the miracle which is wrought for their convenience.

"We ought to go down on our knees when one of these mighty caravans, car after car, spins by us, under the mystic impulse which seems to know not whether its train is loaded or empty."

Even the street railway tycoons began to pay tribute to the electric car as the "emancipator" of the horse. There was good reason to suspect, however, that their zeal for the "emancipation" of man's dumb friend had an economic base. Horses could be worked only two or three hours a day and on very warm days frequently collapsed in their tracks. Streetcar stables were immense and the cost of their upkeep correspondingly large. One official who had just been converted to the use of electric cars explained his conversion with considerable frankness, if not scientific persuasion. "Electric cars never get sick with epizooty or other diseases," he pointed out. "And during strikes or other periods of enforced idleness they do not require to be fed!"

Edison's electric railway system was adopted by the New York Central Railroad. A terrible accident in the smoke-choked tunnels of the railroad leading to its main terminal to New York City awakened the road's harried officials to the need of a safer and more modern means of transportation. Other railroads followed the example of the New York Cen-

tral, and city officials accepted the Edison third-rail arrangement for New York City's extensive subway network.

Edison's experiments with electric transportation were his last at Menlo Park. For many years he had been considering the closing of his workshops there. His various enterprises had grown too large for the limited facilities available at Menlo Park. Moreover, the increasingly strong competition of rivals was forcing on him the need for a larger and more modern headquarters. But Menlo Park held strong ties of sentiment. It was there that the Edison telephone, the phonograph and the incandescent lamp were born. It was his home and Mrs. Edison and their three children loved it. The inventor had spent some of the busiest and happiest years of his life amid those rural surroundings. He hated to close the place.

But an unlooked-for tragedy forced his decision. In the Summer of 1884, Mrs. Edison contracted typhoid fever. The former Mary Stillwell had been in poor health for several years. When the new burden of sickness descended upon her, the worried inventor summoned the best physicians available. He failed to appear in his beloved laboratory for days at a time. He hovered anxiously at his wife's bedside, encouraging her in her fight to live. No matter how weak she felt, she called on her remaining strength to smile at him with deep affection and gratitude in her eyes whenever he appeared at her bedside. But the battle against death was too much for her. Despite her husband's devoted attention and the tireless care that her sister Alice and medical specialists could provide, she passed away on the night of August ninth in the Edison home in Menlo Park.

The death of his pretty young wife left the grief-stricken inventor with three young children to care for, Marion, now eleven, Thomas Alva Jr., aged eight, and William L. Edison, who had recently celebrated his sixth birthday. Edison sent

the saddened children to live with their grandmother Stilwell in New York and decided to end his connection with Menlo Park, which now had only sad memories left for him. He removed his valuable machines and other apparatus and abandoned to the elements the laboratories in which civilization had made some of its most notable advances.

To ease his grief, Thomas Edison plunged into work with a tireless vigor that even for him was phenomenal. Sometimes he spent whole days and nights in the bustling offices at 65 Fifth Avenue.

After thirteen years of a happily married life, the sudden break-up of his home left him moody and lonesome. During his visits to "Grandma" Stilwell to see his three children something of his characteristic good nature came back to him. The sight of Marion and Tom and Bill dissipated his gloom and restored his cheerfulness.

For their part, they were no less eager to see their father. Each Sunday, they rushed through breakfast in a storm of excitement and whiled away the rest of the time until their father's arrival anxiously gazing out of the window for the first sign of him. Eight-year-old Tom and six-year-old Bill needed no gentle admonition from their grandmother or from Marion, who since their mother's death had achieved a maturity far beyond her years, to wash behind their ears. Their faces and hair literally shone as a result of tireless washing and brushing. They wanted to be spic and span for their father's visit!

Shrieks of delight like an Indian war cry shook the house the moment the boys caught their first glimpse of their father's approach. Then Marion went to open the door, while her brothers crowded behind her with unrestrained boyish enthusiasm.

"Hello, father," Marion called out.

"'Lo, Pop," the boys cried out with considerably less dignity. "Why are you so late? We've been waiting for you for hours. Are we going for a ride today?"

The inventor smiled broadly at his children's exuberance as he mounted the steps of the brownstone building that was now their home. He kissed Marion on the cheek and allowed the boys to clamber up into his strong arms to greet him.

"Well, have you rascals been behaving yourselves? You haven't been giving your sister or your grandmother any trouble?"

The boys replied in a torrent of words that left no doubt that in their opinion their conduct since the previous visit of their father represented model behavior.

"How about that, Marion?" the inventor asked his daughter with a wink that only she could see.

"We—ll, let me see," Marion said, enjoying the byplay at the expense of her brothers. She appeared lost in thought, as if she were reviewing in her mind all the misdeeds of the two boys during the past week. Tom and Bill watched their older sister anxiously. But she rarely had any complaint to make. If the boys were inclined to be unduly mischievous at any time, she could usually manage them by threatening to report them to their father on his next visit.

The inventor always had a gift for each youngster. The boys usually received candy and toys. Marion, who enjoyed playing the piano in her grandmother's parlor, could count on her father to bring her the music of some new and popular song and some books.

In the pleasant weather of Summer and early Fall, Thomas Edison would hire a horse and carriage and take the children for a drive up Fifth Avenue and through Central Park. The

noisy foursome drew many sympathetic smiles from New Yorkers out for a Sunday walk as their handsome brown horse and shining carriage trotted along the crowded avenue.

Marion accompanied her father frequently to the opera or to a concert during the Fall and Winter months. Since her mother's death, the bonds of affection and sympathy uniting her and her father had become ever closer. She instinctively felt that he was suffering from loneliness and her manner toward him contained an odd mixture of a growing child and a warmly understanding woman. She "mothered" him by selecting his cigars, supervising his meals and by learning to play all his favorite tunes.

Despite his partial deafness, Thomas Edison's fondness for good music grew with the years. Since his wife's death, it had become almost a passion, providing him with a release from grief and loneliness.

Father and daughter were a familiar twosome at the Metropolitan Opera House. They saw all of the more popular compositions of Giuseppe Verdi—"Rigoletto," "La Traviata," "Il Trovatore" and "Aida." The wealth of melody, the massive ensembles and picturesque Egyptian settings of "Aida" had a particular fascination for Marion. She also liked Rimsky-Korsakov's "The Snow Maiden" but could not become enthusiastic over the operas of Wilhelm Richard Wagner. She considered the depth and solemn grandeur of his music "too heavy" for her liking, except in "Lohengrin," where the wedding scene entranced her.

On their way home, Marion and her father talked and argued about the opera they had just seen. They both enjoyed these discussions immensely. On reaching home, they would sometimes sit at the piano despite the lateness of the hour while she repeated some favorite tune that they both had enjoyed or he, playing simply with his forefinger, sought to

convince her of the beauty of some piece she had not considered very good.

Meanwhile, back at his business headquarters at 65 Fifth Avenue, new and pressing problems had risen which demanded the calm and confident leadership of the inventor to overcome them.

One of the most curious conflicts in American history had developed as a result of a direct challenge to the Edison interests from a new source. In 1884, George Westinghouse, the inventor of the air brake, had founded the Westinghouse Electric and Manufacturing Company.* From the Westinghouse laboratories in Pittsburgh, the new challenger was offering a new type of electric service based on the alternating current.

The key to this new system was the transformer. George Westinghouse demonstrated in public tests that the transformer made it possible to take an electric current of 500 volts, step it up to 3,000 volts for transmission and then reconvert it back to 500 volts at the point of use. The low-voltage direct current system originated by Edison could not be transmitted farther than three miles. Hence, it could not economically supply a territory greater than eighteen square miles. George Westinghouse and the adherents of the alternating current maintained, on the other hand, that the alternating current system could be perfected to supply light and power to a whole State from a single station!

This dramatic struggle between the two titans became known as "The War of the Currents." As the Westinghouse company grew, its rivalry with the Edison interests also intensified. The latter had long looked upon the electric light and power field as their exclusive domain. They were inclined, at first, to treat the Westinghouse invasion of their empire

* See "George Westinghouse: Fabulous Inventor" by H. Gordon Garbedian.

with amusement. Their amusement changed to chagrin and then to bitter anxiety as Westinghouse leaped, like the genie of Arabian folklore from the bottle, into a towering figure offering a direct and serious challenge to their own entrenched position.

The Edison adherents attacked Westinghouse and the alternating current system with charges that alternating current wires, which in those days were strung along poles above ground, were a menace to life and limb. They launched a gigantic advertising campaign in newspapers and magazines and on billboards in which the alternating current was condemned in such lurid headlines as "THE ELECTRIC MURDERER" or "ELECTRIC WIRE SLAUGHTER" or "THE WIRE'S FATAL GRASP."

The clash between the two greatest inventive geniuses of the day and their followers was intensified by an unexpected decision of the New York State prison authorities. In an effort to find a more humane method than hanging for doing away with criminals condemned to death, the authorities adopted electrocution by alternating current. Medical experts expressed the belief that the new method was "the surest, quickest and least painful method that has yet been devised." But the Edison followers seized upon the decision with glee. They broadcast it as proof of their contention that alternating current had already achieved "a record as a man-killer!"

Although Thomas Edison attempted to remain personally aloof from the skirmishing, he was called as a witness when the attorney for the first man condemned to death by the electric chair sought to avoid that form of punishment for his client. He was non-committal when questioned in court on the use of electric current to cause death.

"You are testifying from belief, aren't you, Mr. Edison—not from knowledge?" the persistent attorney wanted to know.

"Only from belief," the inventor retorted. "I have never killed anybody!"

George Westinghouse, who, like Thomas Edison, had maintained a dignified aloofness from the battle waged hammer and tongs by their followers, felt constrained to take notice of these attacks in an article entitled "A Reply to Mr. Edison" for the *North American Review*.

"The alternating current will kill people, of course," he wrote in defense of the alternating current. "So will gunpowder, and dynamite, and whiskey, and lots of other things; but we have a system whereby the deadly electricity of the alternating current can do no harm unless a man is fool enough to swallow a whole dynamo."

Meanwhile, the various Edison companies had grown with amazing rapidity. Edison and his aides decided that they must have a stronger manufacturing set-up and a larger plant outside New York to take care of their expanding business and to combat the aggressive competition offered by Westinghouse.

Enthusiastic representatives from numerous chambers of commerce descended upon Edison with glowing descriptions of their communities and the advantages of settling there. But Edison's choice of a location for his new headquarters was the result of chance. While returning from one of his train trips, the inventor happened to be looking through the window as the train passed through the picturesque little Dutch town of Schenectady in the eastern end of the Mohawk Valley of New York State. The inventor's quick eye noticed from the car window a large tract of idle land along the course of the low-banked, slowly moving Mohawk River.

Back in New York, he summoned John Kruesi. He described to him what he had seen.

"It might be an ideal spot for us," the inventor explained.

"There are two factories, apparently empty, on the site. That would give us a place in which to move some of our machinery, while we were putting up new buildings. And there's plenty of room to grow in, should we need it. I wish you'd go there and inspect the place very carefully. Find out what it would cost and report back to me."

"All right, chief, I'll run up there on the first train in the morning. By the way, wasn't this guy who has been getting in our hair so much lately born there?"

"Do you mean George Westinghouse?"

"Sure—who else!"

"Now that you mention it, I believe you're right," Thomas Edison said smiling. His face broke into a wide grin in appreciation of his own joke as he added cheerfully, "Well, if you give me a favorable report, John, we'll move up there and *that* will give Schenectady something to boast about!"

Two days later, Kruesi returned from Schenectady in an elated mood. The "big flat," as he called the site Edison had observed from his speeding train, was an ideal location in every way.

"But the owners are asking too much money for it, chief," he said.

"How much, John?" the inventor inquired quietly.

"They're asking \$45,000, now that they know we want the land. I offered them \$35,000, then as a last bid, to close the deal, \$37,500. But they insist they won't take less than \$45,000."

"We'll stick by your price, John," Edison declared firmly. "That's plenty high enough for that property."

Both the inventor and the owners refused to budge from their position. For a time it appeared that the impasse over the issue of price would force Edison to cancel his plans to move to Schenectady. At this critical juncture, civic pride took

command of the situation. The townspeople of the community, anxious to have the famous Edison locate his factories in their midst, held a mass meeting and decided to raise enough money to make up the difference between Edison's offer and the owner's price.

The various Edison plants moved to Schenectady and became part of the merger under the name of the Edison General Electric Company. Edison's good friend, Henry Villard, became president of the amalgamation and John Kruesi assumed the title of Assistant General Manager. Within a few months, a huge range of smoking factories lifted their chimneys above the valley and long strings of freight cars bustled in and out, unloading giant piles of raw materials and loading endless crates of finished products.

Three years after the creation of the Edison General Electric Company, the Edison enterprises became part of a still larger amalgamation. In 1892, they combined with the Thomson-Houston Electric Company. On June 1 of that year the combined corporation began operating under the name of the General Electric Company with capital resources of more than \$50,000,000. Schenectady had become one of the great industrial capitals of the country!

The new corporation undertook to manufacture every type of electrical equipment, from lamps to electric streetcars and electric locomotives. Meanwhile, Edison's opposition to alternating current had weakened, with the development of new safety measures, and he became an advocate of low-voltage direct current for distribution and high-pressure alternating current for the transmission of electricity. The new company made equipment for both types and would recommend for a particular installation whichever of the two was best fitted for the work to be done.

The rivalry between the Edison interests and Schenectady's

native son, who was enjoying success in his own right in Pittsburgh, became less intense. The competitors agreed in 1896 to pool many of their patents. Their formerly bitter battle became a friendly rivalry to meet the enormous demands for electric power that neither could fulfill alone.

A friend asked Thomas Edison if he were worried about the rise of George Westinghouse and his company.

"Why should I be?" was Edison's serene reply. "There has to be more than one inventor in the world!"

Edison concerned himself less and less with manufacturing activities as the enterprises that he had founded magnified in size. Skillful industrialists and business men were available to take over the tasks of management. The inventor gradually retired to devote himself fully once again to his own researches. His creative imagination was demanding new outlets for its restless energy. And there was now ready a magnificent new laboratory in which he could give free reign to his fabulous talents.

Chapter Twelve

A NEW ROMANCE

“**A**LL aboard! The Yankee Clipper leaving one o’clock for Stamford, Bridgeport, New London, Providence and Boston. All aboard!”

Thomas Edison took his seat on the train with a light heart. There was no suspicion in his mind that this fine May day in the year 1885 was to be one of the most important days in his life. During the two years since the death of his wife his life had been a continuous round of work. He had frequently suffered from loneliness. Working sixteen and eighteen hours a day had submerged that lonesomeness, but had left little opportunity or inclination for amusement.

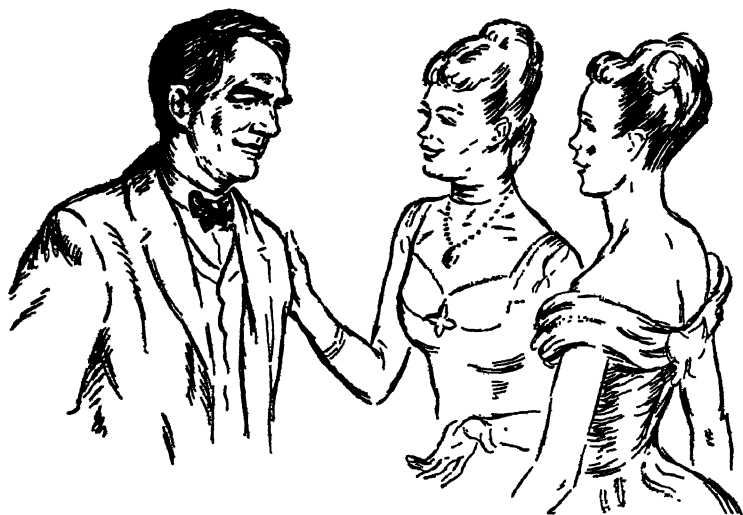
He had been looking forward to this little holiday with relish. He relaxed in his seat beside the open window of the speeding train and enjoyed the view. It was a beautiful Spring day. The sun shone from a cloudless sky with a pleasant, penetrating warmth. Gayly plumed birds, newly arrived from their Winter’s sojourn in the south, shrieked their pleasure with the sun-drenched day as they busied themselves with nest-making amid the gently-waving branches of the tall trees.

As the inventor’s keen eyes took in the rapidly changing scenes of hills and meadows, with an occasional glimpse of the shimmering waters of Long Island Sound beyond, an idea suddenly struck him.

“Why, it’s like a series of picture post cards,” he told himself thoughtfully. “It’s as if the train were a camera, projecting one picture after another—like a pageant moving across a stage. I wonder . . .”

The concept of a new invention had taken root in his restless mind. He determined to work on it upon his return. Meanwhile, his journey to Boston, ostensibly to see an old friend, was not altogether a pleasure trip.

Thomas Edison had invented a system for sending telegraph messages from a moving train. A test on a section of the Staten Island Railroad showed the practical value of transmitting telegraphic signals from a moving vehicle by induc-



tion without intervening wires. So it was with a feeling of killing two birds with one stone that he had accepted an invitation to dinner at the home of the Gillilands. Ezra Gilliland was a friend of the old telegraph days in Boston. Edison meant to enlist his aid in perfecting the new wireless telegraph system that he had devised.

"Oh, Tom, I want you to meet a good friend of mine, who comes from your native state of Ohio," Mrs. Gilliland remarked a bit too casually when the famous inventor appeared

for dinner that night. "This is Mina Miller. Her father is also an inventor!"

"Not Lewis Miller of Akron, who made that mowing machine and grain binder?" Thomas Edison said.

"Why, yes. Do you know him?" Mina Miller spoke with a soft, pleasingly modulated voice. In spite of his partial deafness, Thomas Edison discovered that even when she spoke in a normal tone her voice had a particular quality that enabled him to understand every word without effort.

"Your father visited my laboratory at Menlo Park several years ago to see my phonograph," he said. He was surprised to find a mounting excitement within him. This pretty young woman with the lively brown eyes and handsome chestnut hair seemed to have a strange stimulation upon him. "Mr. Miller was with Bishop Vincent, who, er, was somewhat skeptical about my ability to make a machine talk!"

"Oh, yes, he would be!" she laughed. Her merriment seemed to him as tuneful as the jingle of bells. "The bishop is inclined to doubt almost everything, except his own omnipotence!"

During dinner, the inventor learned that his pretty companion had just returned from an extensive trip abroad after graduating from a Boston seminary. Although only twenty years old, she was an unusually accomplished young woman. She was a gifted musician and was well versed in literature and the social graces. Despite a difference of eighteen years in their ages, she and the inventor got along with the utmost ease. He thought she was as charming a person as he had ever seen!

The Summer that followed was one of the happiest periods in Thomas Edison's life. He spent a large part of it at Lake Chautauqua. Lewis Miller, a leader in educational and philanthropic affairs, had used part of the wealth obtained from his inventions to found the famous Chautauqua Assembly with

Bishop Vincent. It was customary for the Miller family, including most of the six sons and five daughters, to spend the hot months at the lakeside resort. The big Miller boat was the setting for many parties and Thomas Edison became a familiar addition to all of them.

Thomas Edison's prolonged absences from his workshop occasioned a great deal of surprise and speculation. Rumors began to appear in the newspapers. Then, in the Fall, came formal confirmation of what many had suspected. A news dispatch from Akron announced the engagement of the inventor and Mina Miller.

During the Christmas holidays, a few weeks later, Marion, Thomas and William had a visitor whom they had never before seen. The three children had been cautioned by their father, during his previous visit a week earlier, to be on their best behavior to greet "a very pretty lady" who was to be their new mother and who wanted to look after them.

For the first time Thomas Edison was not the center of his children's attention as he walked up the steps of "Grandma" Stilwell's house, laughing companionably with the "very pretty lady" whom he had promised to bring with him. Marion, as well as the two younger boys, quietly watched the slender young woman in the beautiful dark mink coat that swept nearly to her ankles, their eagerness matching the anxiety they felt over the new fateful change that was to take place in their lives and that of their beloved father.

Strain as they might, they could not, at first, catch a good glimpse of her. For she, like their father, was laden with gaily colored packages that obscured part of her face. But by the time the three children had received and admired their gifts, they and Mina Miller were on the best of terms. Mina Miller was only eight years older than Marion and thirteen years older than Bill, the youngest of the inventor's children by his

first wife. She acted like an older sister toward them, made them laugh with amusing stories of her trip from Akron and long before she got up to leave with their father had completely captured the hearts of Marion, Tom and Bill.

Two months later, Thomas Edison and Mina Miller were married in her father's home. The wedding on February 24, 1886 was one of the most brilliant ever held in the Ohio city. Handsome carriages met the train for the wedding guests, who included Edison's close associates of many years—Kruesi, Batchelor, Insull, Upton and others. The ceremony took place in front of the marble fireplace in the Miller drawing room, a large imposing room with brightly painted walls covered with pictorial scenes. Congratulatory messages from all corners of the world poured in by the hundreds. Thomas Edison's gift to his bride was a beautiful necklace of diamonds and pearls.

The newlyweds spent a two-month honeymoon at a Winter home that the inventor had purchased at Fort Myers on the west coast of Florida. It consisted of an old picturesque plantation house with wide verandas set amid landscaped grounds. Beyond the tall palm trees and fiery bougainvillea and hibiscus was the slowly winding Callooshatchee River. There was one addition not usually associated with a honeymoon villa—a portable laboratory, completely equipped with lathes, drill presses, bunsen burners and innumerable bottles of chemicals.

After the blissful Florida vacation, that marked the start of their forty-five years of happy, constant comradeship, the inventor and his bride returned north to Llewellyn Park. There, at the foot of the Orange Mountains in New Jersey's Essex County, about forty miles from New York City, he installed the new Mrs. Edison in Glenmont. Glenmont was an extensive, superbly appointed estate of thirteen landscaped acres with a large Victorian house in rust-colored brick and gabled roofs. Carved balconies and stained glass windows

imparted an unusual dignity to the beautiful mansion. The grounds were laid out like a park. In one corner of the estate were the greenhouses and a barn for several horses and cows and poultry.

The entrance to the house led to the "Grand Hall." This was a palatial room, with a huge old-fashioned fireplace and large oak tables and cushioned window seats, reminiscent of an English baronial residence. A spacious drawing room led off from the "Grand Hall" to one side, while on the other was the Edison library. Book-lined shelves stretched from the floor to the ceiling of the library. The thin daylight filtering in through a stained-glass window from which Dante's head glowed gave the room a mystic character. On the floor above were the sleeping quarters and the inventor's favorite room—his den, where he could work, if he wished, while at home.

Marion, Tom and Bill moved to Glenmont shortly after their father and stepmother had returned from Florida. Marion had a room to herself, painted in the colors she liked, while the two boys shared a large chamber from whose windows they could glimpse the distant hills. The children were delighted with their new home and happy in the opportunity to see their father every day. The former Mina Miller, with that complete lack of jealousy or pettiness that was characteristic of her, hung a portrait of Mary Stillwell Edison in her boudoir.

Home meant more to Thomas Edison than it does to most men. He never played golf. Sports in any form held little interest for him. Bridge and card games bored him. What he loved to do above all else during his leisure hours was to wander among his gardens and listen to his wife play on the grand piano in the drawing room. Beethoven was his favorite musical composer.

"Some day," he would tell his wife, "I am going to make a

record big enough and perfect enough to reproduce the entire Beethoven Ninth Symphony in all its glory. That music is the world's greatest masterpiece!"

The affectionate companionship that linked the two had a profound influence upon the inventor. Domestic happiness made him amiable and sympathetic with other men. Gradually, some of his brusqueness and stiffness, the outgrowth of the rough days he had spent in his wanderings as a nomadic telegraph operator, softened. He became more mellow. He remained simple, natural and unaffected. Those were basic characteristics that nothing could change. But under his wife's diplomatic maneuvering, he became more polished, more inclined to accept social diversions and less insistent on spending every waking moment at a workbench in his laboratory.

He read much more. He smoked much less. Absorbed in his work, he would sometimes consume one cigar after another. In the course of a day a whole box of the strongest cigars that he could obtain would disappear.

"Tom," Mina Edison said to him one day, "you have been smoking too much again. It's not good for you."

"But I'm in perfect health, Mina," the inventor remonstrated. "My nerves were never steadier. If I had to, I could stop smoking any time I wanted."

"There is no need of stopping altogether. But I do think smoking a whole box a day is bound to affect your heart and your nervous system. I wish you'd promise me to smoke only after meals, and perhaps one or two in the evening while you're resting at home."

"All right, Mina," the inventor promised reluctantly. Ever eager to please his wife, he gave up his one vice without even a struggle. "I'll make a bargain with you—one cigar after each meal and two each evening. That's only five altogether."

Despite her youth, Mina Edison was well versed in the

standard works of the outstanding authors of England, France, and the United States. She taught her husband to like Dickens and Scott and Jules Verne. Hawthorne's "Scarlet Letter" became a favorite of his. But above all other reading Thomas Edison liked books centering around a mystery. He who had spent so much of his life unveiling some of the most jealously guarded secrets of Nature delighted in following the exploits of an imaginary sleuth entangled in the middle of an intricate plot. The writings of Edgar Allan Poe, particularly "The Murders in the Rue Morgue," absorbed him.

Mina Edison was quick to realize her husband's special fondness for tales involving mystery and adventure. Whenever the inventor appeared tired from too many hours in the laboratory, she sought to divert him by calling his attention to a new book she had been holding in reserve for just such a purpose.

"Oh, Tom, have you read 'The Three Musketeers'?" she asked innocently one night after dinner. Thomas Edison had returned home in a distracted mood. Despite her repeated efforts at light conversation, he had answered her only in monosyllables. Following the meal, he had returned to his den, to pace up and down the room restlessly. It was obvious to his wife that the inventor's mind was enslaved by some extremely difficult problem for which he could not, at the moment, find a solution.

Rising from her seat, where she had been listening anxiously to her husband's nervous footsteps, she walked to the library. She knew exactly where to go. She picked up Dumas' masterpiece and firmly entered her husband's sanctum.

The inventor did not hear her the first time. She repeated her question. "Tom, here's a book I'm sure you would enjoy. You've never read 'The Three Musketeers' by Alexander Dumas, have you?"

"No, Mina. I've never heard of him."

"Oh, yes, you have, too," she laughed gently. "Don't you remember that book about the Count of Monte Cristo that you liked so well? He was the author of that, also."

He nodded with new interest. "Yes, that was a very exciting yarn. A fine book. I stayed up all night to finish it," he added a bit ruefully, half expecting the rejoinder that his wife was quick to make.

"Yes, I remember that, too," she chided him with severity that both knew she did not mean. "And you had promised faithfully to go to bed on time."

"Staying up all night doesn't hurt me as it would some people," the inventor put in hastily. "Is this book as good as the other one?"

"I think it is. Do you want to try it?"

"Yes, I think it might do me good to read for an hour or so before going to sleep. I've had a hard day. We've been trying to solve a problem that doesn't seem to have a solution."

"Perhaps you'll have better luck tomorrow after a good night's sleep," she said sympathetically. She handed the thick volume to him and added, "A few chapters of this will help you to rest your mind. But please don't overdo it!"

"I won't," he promised. "Thank you for the book. I really do feel a bit tired. I shall turn in before long." He took the volume with its bright red binding from her extended hand and bent over to kiss her. "Good night, my dear," he said.

Settling himself comfortably in his favorite armchair, the inventor quickly became absorbed in the fascinating romances, the miraculous adventures and hair-breadth escapes of D'Artagnan, Athos, Porthos, Aramis, and the other swashbuckling heroes of the great Dumas masterpiece. The morning dusk had faded and the sun was pinking the sky when he finally finished the book and set it down.

He tiptoed to his room and quietly rumbled his bed. He hoped, not too confidently, that his wife would accept that as evidence of his having slept in it. Then, slapping a hat on the top of his head, he walked with a quick step and a fresh mind to his laboratory.

"That was a very fine book you gave me to read last night," he told his wife happily upon his return for dinner that evening. He had not slept for thirty-six hours but he hoped that his gay manner and his news would divert any suspicions she might have as to his sleepless night. "That D'Artagnan and his buddies are fine fellows. They helped me to find the answer to a very difficult puzzle!"

Although he did not like society and the social affairs that occupied so large a part of other people's lives, Thomas Edison, under his wife's influence, became more amenable to the pleas of those who wished to give him public honors. She traveled with him and sat beside him at banquets and other ceremonial gatherings at which the nation's leading societies bestowed medals and decorations upon him.

When the French Government beckoned "the genius of the age" to the Paris Centennial Exposition in 1889 it was Mrs. Edison who persuaded the inventor to accept the invitation. The two, accompanied by Marion Edison, now a pretty schoolgirl of sixteen, were the center of attraction in Paris. Excited crowds gathered wherever the famous inventor appeared.

One-third of the space given to American exhibits at the show was occupied by Edison. A gigantic incandescent lamp, forty feet high on a pedestal twenty feet square, dominated the exhibition. Visitors were awed by it and the other Edison displays, including the latest models of the "talking machines." But the throngs considered the father of these inven-

tions even more sensational. The enthusiastic reception accorded Edison was so great that all Paris forgot its dozens of royal visitors and avidly followed his every move. His lack of ostentation and his good-humored simplicity won the heart of the city. No other distinguished traveler from overseas since Benjamin Franklin had received such great public acclaim.

The city of Paris struck a gold medal in honor of the American inventor. It also tendered him the biggest dinner that he ever saw. The gigantic banquet was scheduled to take place in and around the newly completed Eiffel Tower, whose 984 feet of height made it at that time the tallest structure in the world. Almost 9,000 diners, including every notable person in the French capital, was invited to the affair, the outstanding social event of the year.

Both Mina Edison and Marion were greatly excited when the invitations to the dinner, signed personally by the President of France, arrived. Both of them decided that neither had anything in her wardrobe fit to wear to so glamorous an occasion. So the two left their hotel, arm in arm, for a shopping spree.

Marion, in particular, was vastly excited by her first venture into the luxurious French shops. Before setting out, she had pleaded with her father for permission to get an evening gown—her first.

"Aren't you too young, Marion, for that sort of thing?" the inventor, who like most parents hated to see his firstborn grow up, demurred.

"But, father, every other woman at the dinner will be in evening dress."

"Perhaps every woman will. But you are not a woman yet—you're a child."

"I'm sixteen years old, father," Marion exclaimed tearfully.

"Many of the French girls you see around Paris about my age are already married. If a girl is old enough to get married at sixteen, she's old enough to wear an evening gown!"

As the inventor hesitated, Marion's stepmother came to her rescue.

"Oh, Tom, you needn't be so old fashioned," she said. "Many girls of Marion's age are allowed to wear evening gowns these days. I think Marion will look very pretty in one!"

The inventor broke into laughter and threw up his hands in mock surrender.

"I give up," he cried. "I might have a chance to win an argument against one of you—but with both of you in league against me I know I haven't a ghost of a chance!"

Thomas Edison was quite proud of his "womenfolk," as he jocularly referred to his wife and daughter, when the time came for them to leave for the gala dinner. Mina Edison wore a sky-blue velvet gown. Marion was demure and beautiful in a gown of flame chiffon with a beaded bodice. Each of them wore a corsage of orchids which the inventor had selected for them.

"Much as I hate these big functions, at least I'll have one thing over all the other men at the dinner," Thomas Edison said slyly as they walked out of their hotel apartment.

"Why, what do you mean?" the two women asked, almost in one voice.

"Well," exclaimed the inventor, with a broad smile, "I'll be in the company of the two best looking girls!"

A highlight of the dinner was a special recital by the great French composer, Charles Francois Gounod. The creator of *Faust* and other masterpieces, then seventy-one years old, composed a special piece of music in tribute to France's honored guests and, after playing it, presented an autographed copy to Mina and Marion Edison. President Carnot of France brought

the festive affair to a close by decorating the inventor as a Commander of the Legion of Honor.

The wearing of the little red button, indicating his rank, presented a problem to Edison, who hated any form of personal adornment.

"My wife had me wear it," he confided to his intimate cronies, upon his return home. "But whenever I saw any Americans approaching I would quietly slip it out of my lapel, as I thought they would jolly me for wearing it!"

Before leaving Paris, Mina and Marion Edison made another shopping trip. This one was for the family and friends at home. For Tom, now thirteen years old, they obtained an elaborate painting set. For Bill, whose eleven years still allowed him to enjoy playthings, they bought a rocking horse and a replica of the Eiffel Tower. This replica was enclosed in a large glass globe, set on a decorative marble stand. When the globe was inverted and then righted, chemicals imprisoned inside suddenly crystallized and a heavy snowstorm appeared to be falling all about the famous tower, creating a fairyland-like scene of great beauty.

The receptions accorded the Edisons in Berlin, London and Rome were as enthusiastic as that in Paris. In the Italian capital, the inventor received the insignia of the Grand Officer of the Crown of Italy, which made him a Count and Mrs. Edison a Countess.

Edison's friends gleefully seized upon King Humbert's decoration and began addressing the greatly embarrassed inventor as "His Highness, Count Edison." The former train-boy enjoyed his European trip. Upon his return to his native land he said it had been a "magnificent experience, but I feel that the honor belonged to America, not merely to me."

"There were dinners, dinners, dinners, all the time," he related in a humorous description of his travels. "But in spite

of them all they did not get me to speak. Once I got Chauncey Depew to make a speech for me and I got Whitelaw Reid, our Minister to Paris, to make three or four, I could never get used to so many dinners. At noon I would sit down to what they called *dejeuner*. That would last until nearly three o'clock, and a few hours later would come a big dinner. It was terrible!

"It reminded me of the story of the farmer who went to the big city for the first time and, in a burst of extravagance, registered at a good hotel. He unpacked his bag and then went to the desk to inquire about the meals.

"*'What is the eatin' hours in this yere hotel?'* he said to the clerk.

"*'Breakfast,'* the clerk answered, *'seven to eleven; lunch, eleven to three; dinner, three to eight; supper, eight to twelve.'*

"*'Jerusalem!'* exclaimed the astonished farmer, *'when am I goin' to get time to see the town?'*

"I ate only one American dinner while abroad. It was given by Buffalo Bill. Now I feel I must starve for a few months in order to get straight again after all those dinners. I wonder they didn't kill me!"

Despite the great success of his European trip, Edison steadfastly refused to play the role of a social lion. His personal life continued to be centered in his workshop and in his home. Aside from these two places, he had few interests. And he wanted none.

His pride in his home and his affection for its reigning queen mounted with the years. Visitors to his home would often remark on the magnificence of the Edison residence and the beauty and good taste of its decorations.

"Yes, it's very nice," the inventor would agree. Then he would gently take hold of Mina Edison's arm and add, "It's really a great deal too nice for me, but it isn't half nice enough for the little wife here!"

Realizing that her husband was not, and never would be, the clubbish or good-mixer sort of man, Mina Edison devoted her efforts toward making his family circle as attractive as possible for the inventor.

During the Summer following their trip to Europe, Mina Edison became a mother for the second time. On Aug. 3, 1890 a son was born to her and the inventor. Charles, as he was named, was to grow up to become the best known of the Edison boys and as Secretary of the Navy and Governor of New Jersey to carry on the fame of his father's name. A few years before a girl, Madeleine, had joined the growing household, and in 1898, the third, and last of the inventor's children by his second wife, Theodore, was born.

This increased the family circle at Glenmont to a total of four sons and two daughters. It was a happy group. The inventor loved to devise new games and recreations for his children. He frequently returned from the laboratory with some alarm clocks for the boys and watched with keen interest as the boys joyously took them apart under his supervision. He gave them a steam engine which ran by an alcohol flame and was as exuberant as any of the boys in watching it operate.

Never failing to enjoy a prank, the inventor one day erected a fifteen-foot pole on the grounds. The Edison boys and their neighborhood friends vied to "shinny" to the top, where the inventor had placed a large silver coin. When some of their friends proved more skillful than the Edison youngsters in this sport, the inventor was somewhat disappointed. He said nothing. But the next time a similar contest was to be held he rubbed a chemical mixture on the knees of the pants worn by the Edison boys to cause a friction on the pole. After that, the Edison boys had no trouble in reaching the top of the pole and were regular winners, much to the chagrin and amazement of their playmates.

The inventor set aside a room in his laboratory for the use of his sons. The boys—all of whom were to join their father's vast enterprise upon graduation from college—loved to watch their father experiment and sometimes branched out on some investigation of their own. One day, one of the boys, who had decided to test some explosives with the idea of inventing a floating bomb, caused a sharp explosion which shattered many of the windows. A doctor had to be summoned in a rush to extract pieces of glass from the hands and face of the boy. Thereafter Mina Edison decreed that any future experimenting by any of the boys would have to be made with the permission of their father and under his supervision.

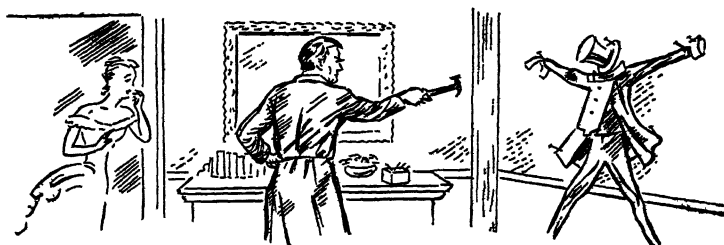
Christmas was always a joyous season in the Edison household. If Thomas Edison was ever able to put aside his work, he could do it more easily during that holiday period than at any other time. He loved to join his wife and children, as excited as the youngest of them, in decorating the large tree that was always placed in the center of the large hall. The children had little trouble in persuading him to play a game of parchesi with them on the nights he spent at home during the festive season. But the inventor enjoyed most of all to gather his brood about him around the piano, and, to the accompaniment of Mina Edison's playing, conduct a rousing songfest, with all of his favorite Christmas tunes.

Mina Edison succeeded, after a long campaign of diplomatic maneuvering, to induce her husband to employ a tailor. After one visit, Thomas Edison never again went near the shop. However, his wife suggested to the tailor that he make a model of her husband's figure. For more than twenty years, the tailor cut the inventor's clothes from this model. Since Edison's weight remained almost constantly at 182 pounds, this "conspiracy" between his wife and the tailor managed to keep him reasonably well dressed. Whenever his wife decided

that he ought to have some new clothes, she ordered the tailor to make several new suits for him, usually in dark blues or grays, which he liked.

To Thomas Edison, clothing was simply a covering for the body. Others could adorn themselves in their best "bib and tucker." He would have none of it. He considered elegance, in dress, or any kind of personal decoration, "all right for the savages" but in extremely bad taste for human beings who ought to have more important things to think about.

He seldom wore an overcoat. If Winter's cold was more rigorous than usual, he would don an extra set of undergar-



ments. He disdained gloves. He had a particularly strong aversion to full dress clothes.

Mrs. Edison pleaded with him to wear a full dress suit for a formal reception one day. It was the first and last time he consented to do so. The inventor squirmed in discomfort all evening.

"Mina, I can't stand this doggone straitjacket any longer," he groaned at last. "Let's go home."

Back in Glenmont, he tore off the offending dress suit. Then he made certain that it would never bother him again. He took hammer and nails and nailed the suit to the wall.

"There," he said triumphantly when finished, "I hope you suffer as much as you made me suffer!"

The inventor was in the habit for many years of donning a long linen duster—a sort of masculine “Mother Hubbard”—when working in his laboratory. It became threadbare after long usage. But the inventor, with his usual negligence about such things, had not noticed how shabby it had become until an amusing incident brought it to his attention.

A youth by the name of Nick was hired to guard the gate to the inventor’s laboratory. He was admonished that his main duty was to see to it that no strangers who might bother Mr. Edison were allowed to pass through the gate. He had been on duty only a short time on his first day when he saw approaching what appeared to be a tramp in a ragged wide-brimmed slouch hat pulled low over his broad face and a long, dirty coat that had long since lost almost every trace of its original yellow color.

“Here, where do you think you’re going,” Nick asked in a brusque voice as he set himself to block the stranger’s path. “Don’t you know you can’t come in here?”

“Why, no,” a surprised voice answered him. “I didn’t know. Do you mind telling me why I can’t come in?”

“Because those are Mr. Edison’s orders. He doesn’t want to be bothered by tramps or anyone else who might disturb him.” Then the boy added proudly, “He has important work to do. Just what do you want, anyway?”

“Well,” the stranger volunteered with a twinkle, “what I want to do is come in to the laboratory. There is some work I want to do, though I don’t know how important you might consider it. You see, I own this place.”

A shriek of laughter was the boy’s reaction to this incredible statement. Now Nick was sure that shabby stranger was not only a tramp but also out of his head.

“If you want something to eat,” he said not unkindly,

"here's a dime for a sandwich and a cup of coffee. But," he added firmly, "you can't come in here. Those are my orders."

The stranger smiled as he said, "No, thank you, perhaps you'll need the dime yourself." Then he turned on his heel without another word and briskly walked away. Five minutes later, Nick gaped in astonishment. The "tramp" was coming back. With him was the foreman who had hired him to guard the gate.

Nick watched the approaching foreman with some trepidation as well as surprise. The foreman seemed to be quite displeased about something.

"Boy," he called out angrily while still a few feet from the gate, "why didn't you let this gentleman enter the laboratory?"

"Because my orders were not to let anyone through unless he has a signed pass from Mr. Edison," was Nick's nervous reply.

"But this is Mr. Edison himself!" Then the foreman started to give the boy a severe scolding about his "stupidity." The inventor restrained him. "It's not the boy's fault," he pointed out. "He had his orders. And he was following them."

Nick expected to be fired. Instead, the inventor called him into his office and made him his personal attendant as a reward for his faithful discharge of orders.

Mina Edison's keen eye for her husband's concern was quick to notice that the inventor was no longer wearing his favorite "Mother Hubbard" outfit.

"What has happened to that awful linen duster?" she asked hopefully. "Did it fall apart from old age and dirt?"

"Er, not exactly. I decided to throw it away yesterday."

"At last! I've been on the verge of throwing it into the furnace several times. But I knew how fond you were of the frightful thing. What made you decide to get rid of it?"

With that complete lack of vanity which was so characteristic of him, Thomas Edison cheerfully told his wife of his amusing experience with Nick. She smiled and then broke out in unrestrained laughter as he good-humoredly described how his old clothes had barred him from his own laboratory, and he joined happily in her merriment.

Chapter Thirteen

FATHER OF THE MOTION PICTURE

A^F**T**^E**R** settling in Glenmont following the return from his honeymoon trip to Florida, Thomas Edison's first concern was the erection of a new laboratory. To be near his bride, he wanted a site not far from his home. About a half-mile from Glenmont, on the outskirts of the town of Orange, were large open fields. He bought them.

"I want the finest laboratory in the world built here," he ordered. "It must be complete in every detail. The stock room must have every sort of material. At one time, I was seriously hampered in my work by not having the substances necessary to enable me to pursue my investigations. But now I intend to have at hand the equipment so that any experiment may be carried out, if necessary, at a moment's notice."

In the days when, as a lad of eleven, he had created a little laboratory for himself in a corner of his father's cellar, Thomas Edison had often dreamed of possessing the sort of laboratory that now gradually rose under his vigilant supervision. The five buildings that came to life on the flatlands in the valley of the Orange mountains during 1887 made up the largest and most complete private laboratory the world had ever known.

The main structure was 250 feet long and three stories high. It contained a fine library, with room for 60,000 books, scientific magazines and other technical publications. A copy of every available magazine and journal dealing with scientific research published in the preceding fifty years was on file.

The inventor's desk was located in a corner of the library. On the wall nearby hung a framed letterhead of the Detroit

Free Press. It contained a single sentence. A patient, keen-eyed observer could decipher the almost illegible scrawl. It read:

Give this boy all the papers
he wants on credit.

W. F. S.

The other buildings were equipped with chemical laboratories, a galvanometer workshop, carpenter and machine tool benches and general offices. There were rooms for grinding and polishing metals, drafting and precision work, X-rays and photography. The stock room was an inventor's heaven. It contained materials of all kinds—ores, metals, fabrics—to last for five years. There were thousands of small drawers, reaching from the floor to the roof. They were crammed with ten thousand different kinds of chemicals, and an odd assortment of such things as needles, shells, macaroni, inks, sharks' teeth, bones, gums, feathers, hogs' bristles, human hair, animal hides and rare and precious substances that had to be kept, like diamonds, in small folds of tissue paper.

Thomas Edison was immensely proud of his stock room and its contents. He believed it contained everything, no matter how rare or "queer" the substance, that any scientific investigator might need at any time. To make sure of that, he put up this sign:

REWARD

I will pay a reward of \$1 to any employee who fails to find any substance used in science in the stock room.

Thomas A. Edison

At first, the inventor's staff found it an interesting game to

unearth some rare material that the staff in charge of the stock room might have overlooked. They managed to earn an occasional dollar. But the contest became too tough and they gave it up. However, they all enjoyed confiding to a green employee, as "a very special favor," about the reward and persuading him to try for it. It did not take the new man long to learn that the joke was on him.

However, to the inventor's vast amusement and the astonishment of his staff, a new office boy once won the prize on his first day of work.

"Please let me have a clothespin!" he asked a stock room clerk. The mischievous smiles on the faces of the ingenuous boy's co-workers turned to good-humored chagrin when a hunt among the tens of thousands of substances in the stock room revealed that a common clothespin could not be found!

Despite the rise of Thomas Edison to an eminent position throughout the world, the relationship between him and his workers continued on a thoroughly democratic basis. To the inventor, his workers were his colleagues—his aides in the hunt for Nature's secrets and for new discoveries that would promote the welfare of mankind. He worked hard—even after Mrs. Edison had persuaded him to give up night work he continued to labor twelve to fifteen hours a day—and he expected his workmen to share his passion for invention and work. He paid generous wages, often remarking that any employer "who pays his men poor wages and then expects good results is a big fool!"

In their turn, his men looked upon Edison affectionately as "the old man" or "the chief." Any of them was free to approach the affable and genial inventor to discuss with him any problem as if Thomas Edison were an associate, rather than an employer who enjoyed world fame. Edison's more

intimate associates did not hesitate to play practical jokes on him. He loved a laugh, even when it was at his expense, and he himself frequently played jokes upon his colleagues.

One such prank, however, backfired. The inventor carefully plotted "revenge" against his friends in the laboratory, only to fall a victim of his own absent-mindedness!

After promising his wife to cut down on his smoking, the inventor, true to his word, maintained a careful watch on himself in order not to exceed his daily allowance. But the boxes of cigars in his private laboratory continued to vanish as quickly as before!

So he called on his tobacconist and asked him to make up a special order.

"My men have been raiding my cigars," he explained. "They drop in on me while I'm working, chat for a few moments, and then help themselves to some of my smokes on their way out. I want to break them of the habit. Can you make up a dozen boxes of specially vile cigars?"

"I'll prepare some cigars for you that would make the heaviest smoker in the world swear off cigars for the rest of his life," the dealer promised with a laugh. "You can have them in a week!"

The inventor returned to his laboratory in high glee over the anticipated discomfiture of his aides. Then he became absorbed in an experiment and forgot all about the joke he had planned. Weeks later, he happened to think of it again and paid another visit to his tobacconist.

"What happened to those boxes of fake cigars you were going to make for me?" he inquired. "Did you forget to send them?"

"No, I did not," the dealer replied in surprise. "I made them up myself from old bits of rags, tea leaves and shavings. They were delivered to your office two months ago. They were

the worst concoctions I ever saw. I took one smoke from one of them and was so sick I called them life destroyers! Aren't your men through with them yet?"

The inventor suddenly remembered that fewer visitors than usual had been dropping in on him of late. He swiftly multiplied his daily allowance with the number of days that had passed since those boxes had been delivered to him. The total approximated that of the contents in the boxes.

"The joke's on me," he confessed with a mental shudder, "I never realized those boxes contained the special cigars you were to make for me. I must have smoked them myself. Get up a hundred boxes of my usual brand and send them up—that ought to be enough to keep everybody happy for a while. Now I'm going back and throw out any of those 'life destroyers' that might be left!"

Back in the laboratory, Edison amiably told his friends how he had become a casualty of his own strategy. No one's merriment was more sincere than that of the inventor at this new proof of his absent-mindedness. When the new shipment of attractively-boxed cigars arrived, their contents began to disappear again with familiar rapidity.

This mental abstraction of the inventor's sometimes led to embarrassing situations. More than once a distinguished visitor, or group of visitors, calling at the Edison laboratory would be surprised to find the inventor, after a hurried word of apology, had left them and had forgotten to come back. An anxious search disclosed that an idea had taken sudden hold of Edison's mind. He had simply forgotten all immediate problems and had hurried to his laboratory to test out his idea!

At another time, Edison visited the Patent Office in Washington in connection with one of his applications. Another caller was ahead of him. While waiting his turn, he became

preoccupied with a mental problem and forgot his surroundings.

"Mr. Havens is free now," the official's secretary announced. "Who shall I say is calling?"

Edison, still deeply absorbed in his problem, looked blankly at the chic young woman for a panic-stricken moment or two.

"Er—what did you say?—ah, my name. Gosh, I'm afraid I've forgotten it!"

"You don't know your own name?" cried the astonished young woman. "But that's impossible!"

"You're absolutely right," the inventor volunteered sheepishly. "I bet you think I'm a little bit crazy!"

The young woman was eternally grateful that she restrained a frank response to that question. Her superior emerged at that moment from his inner sanctum and recognizing the famous inventor hurried to him with outstretched hand.

"Hello, Mr. Edison," he called out cordially. "It's fine to see you again. Come right into my office."

As he got up to accompany Havens to the inner sanctum, the smiling inventor stopped momentarily beside the stunned young woman and, with a twinkle, whispered, "I just remembered—my name is Thomas Alva Edison." She collapsed into the nearest chair.

One day, the inventor, who had been working at a stiff pace of sixteen hours a day for several days in connection with an important invention, decided he needed a rest. He called Nick, said he would lie down for a nap in his office until two o'clock, and asked that luncheon be ready for him at that hour.

Promptly at two, Nick shook the inventor awake.

"Your lunch will be here in a few minutes, Mr. Edison," he said.

The inventor, still feeling drowsy, fell asleep again as Nick

left his office. Meanwhile, Charlie Batchelor had taken in the situation. He had more cause, perhaps, than anyone else to know about the inventor's famous absent-mindedness. He waylaid the boy with the tray bearing the inventor's meal, then quietly deposited the debris of his own luncheon at the inventor's desk. Edison roused himself a few minutes later. He noted with some surprise the luncheon remnants upon his desk. After a moment's reflection, he concluded that he had eaten his mid-day meal and had forgotten about it. He pulled out a cigar and prepared to enjoy his usual "after-meal" smoke.

At that moment, Batchelor entered with an impish smile on his face and a full tray in his hands.

"Chief," he inquired with mock innocence, "this tray was outside your door. Would you like some lunch or have you already had it?"

"Bring it right here, you rascal," the inventor roared good-humoredly. "I couldn't understand why I was feeling so hungry"—he pointed with some disgust to the remains of the bountiful repast spread on his desk—"after eating all that!"

The first great work to come from Edison's new laboratories consisted of the motion picture camera and the projector. These twin inventions gave the world a new and wonderful art medium that was also to become the world's incomparable traveler, historian, schoolmaster and for millions of persons every day a major source of entertainment and happiness.

Edison, thinking about the panorama of swiftly changing scenes that greets the eye of a traveler beside a train window, decided that he could produce the illusion of animated photography. He believed that he could achieve that age-old dream with the aid of a swiftly-moving camera. He calculated that if photographs of a moving object were taken at the rate of forty to fifty a second, the still photographs could later be thrown on a screen in a way to reproduce the original move-

ments. Under the compulsion of mechanical motion, the little pictures would appear and disappear so quickly that the human eye would be unable to detect the change from one position to the other. It would be deceived into accepting a series of still photographs as a reproduction of the natural movements of the original subject!

Thomas Edison had never taken a snapshot, developed a plate or even touched a camera when he first determined to invent the art of the motion picture! With his customary zeal, he plunged into an exhaustive study of photography. Fifty years earlier, in 1838, Niepce and Daguerre had invented photography in France. In 1860, another Frenchman invented a popular mechanical toy. It was known as the Zoetrope or Wheel of Life. It was so called because when one spun it and peered through a peephole at fast-flitting pictures of a horse drawn on the interior he received the impression of almost continuous movement. In order to settle a bet whether a galloping horse had all four hoofs on the ground at any one time, Leland Stanford hired a photographer, in 1878, to make pictures of a horse trotting around a California race track. A series of cameras were arranged at intervals of a few feet along the horse's path. The shutter of each was operated when the horse, as it passed by, snapped a string that was stretched across the track. When these pictures were mounted in a Wheel of Life, and that toy was rapidly rotated, the illusion of a galloping horse was obtained.

Early in his work, Edison realized that before rapid photography could be achieved a light, flexible medium had to be found to replace the bulky glass plates then prevalent. He traveled to Rochester to confer with George Eastman, a manufacturer of dry plates.

"We have developed the apparatus for taking high-speed photographs," he told Eastman. "But your glass plates are

cumbersome, break easily and aren't sensitive enough to take clear impressions. Isn't there something you can do about making a flexible tape-like film?"

Eastman promised to try. He set to work experimenting with transparent paper covered with a chemical emulsion. When celluloid was used as a base a satisfactory substitute for plates to receive photographic exposures was found. A roll of the new film, long enough to take one hundred pictures about three inches square, was sent to Edison.

"Eureka!" Edison called out in his delight when he saw the roll of continuous highly sensitized paper. "We've got it, boys! Now work like hell! It's only a question of time now before we shall be able to combine the motion picture and the phonograph in a way to present a whole opera on the screen."

Edison called his apparatus for taking motion pictures the kinetograph. He received a patent for it in 1893. It was the first practical motion picture camera in the world. His projector, which enlarged the small pictures and cast them on the screen, was known as the Vitascope. Actually, the Vitascope, in its essential details, was the kinetograph reversed.

This first motion-picture camera took forty-six photographs a second, or twenty-seven hundred and sixty a minute. Perforations were made on the outer edge of the film which was affixed to a rotating disk. These locked with a swiftly-moving device that held the film steady for the fraction of a second needed for the shutter to open and admit a beam of light to photograph the image. In the Vitascope, an arc lamp in the rear of the apparatus, which was linked with an induction coil, lighted up the photographs and projected them through the magnifying lens onto the screen.

Edison erected a long, oblong building with a movable roof in the yard near the laboratory to make motion pictures. This barnlike structure could be revolved on a circular track. This

made it possible to swing the camera and the stage with the sun. Because it was painted black, outside and in, it was known as the Black Maria. It was the first motion picture studio in the world, the forerunner of the lavish splendor of Hollywood and a multi-billion dollar industry. The first films were of famous dancers and acrobats, of an Italian organ grinder with his monkey, children skipping rope and a man noted for his specialty of gigantic sneezing. James J. Corbett, who had won the world's heavyweight championship by beating John L. Sullivan, visited West Orange to box a few rounds before the camera. When the Negro pugilist who had been hired to oppose Corbett recognized the champion, he turned on his heel and raced out of the studio. He did not stop running until he reached the safety of his home. When Edison could stop laughing, he located another boxer for the act and the film was finished.

Edison's enormous knowledge of electric lighting and its uses enabled him to achieve spectacular results of breathtaking beauty. It was impossible to match on any stage on Broadway some of the marvelous scenic effects he was able to create in his motion pictures with his extremely powerful incandescent lamps.

The residents of Orange delighted to throng to the Edison laboratory when an outdoor "super-feature" photoplay was to be made. And in the forefront of the crowd one could almost always find some of the Edison children.

"Camera! Action!" This piercing cry of the director proved to the thrilled spectators that not only was the world a stage but with the aid of the motion picture camera the silver screen was about to become a new and highly exciting world!

British and Boer troops "fought" a sham battle in the peaceful setting behind the Edison laboratory, romance flourished as it rarely does in real life, villains dynamited railroad bridges

and heroes arrived in the nick of time to safeguard their fair maidens who were "pure as the driven snow" and insisted on remaining so! A popular stunt film of the period was the amusing episode of the painter seated in the middle of a railroad track, so absorbed in his work that he is unaware of the onrushing express. The spectators gasped in horror as the speeding express crashed into the luckless artist and sent him



and his paraphernalia in scattered fragments all over the landscape. But as the train dashed by, lo and behold! the broken fragments pulled themselves together—and the hardy painter rose in his indignation to shake an angry fist at the departing train that had interrupted his artistic endeavors!

After perfecting the technical apparatus for making and projecting motion pictures, Edison was content to turn over the development of the art of the silver screen to the showmen. He easily might have dominated the new industry if

he had chosen to do so. But he wanted to go back to inventing. He met with the representatives of new-born motion picture companies in the library of his home and signed his patent rights over to them so that they might organize the Motion Picture Patents Corporation.

"The motion picture will become the most powerful instrument in the world for good and evil," he told them. "Whatever part I had in its development was mainly along mechanical lines. The far more important development of the motion picture as a medium for artistic effort and as an educational factor is in your hands. Do not let the desire for money or power prevent you from giving the public the best work of which you are capable. It is not the quantity of riches that counts—it's the quality which produces happiness, where that is possible."

The motion picture industry frequently acknowledged its debt to the inventor in the years that followed. It held a big dinner in his honor on his seventy-seventh birthday in 1924 and in 1938 placed this tablet on the Thirty-fourth Street side of the building in New York occupied by the R. H. Macy & Co. department store:

Here The Motion Picture Began
On the night of April 23, 1896, on this
site, in Koster and Bial's Music Hall
Thomas A. Edison
with the Vitascope
First Projected A Moving Picture

In commemoration of that event this tablet is
~~here~~ affixed by the Motion Picture Industry.
October 4, 1938.

Chapter Fourteen

BUILDER OF CIVILIZATION

DURING the Winter of 1896, while on his way to his son's Florida home at Fort Myers, the redoubtable Samuel Edison suddenly fell ill on the train. Nature had endowed few men so generously with a powerful physique, keen mind and robust spirit. But even the hardest human clock must tick its final tick sometime. And on February 26, ninety-two years after his birth in 1804, the colorful old man, still as valiant in spirit as in the days when he had led a rebellion against the Canadian Tories, passed on.

Thomas Edison accompanied his father's body to Port Huron and watched sadly as it was buried beside his mother's grave in the Edison plot. On the way back to Glenmont, the inventor stopped over in Detroit to confer with officials of the Detroit Edison Illuminating Company. His hotel was next door to the central power station of the company. The chief engineer of the station was a young man of thirty-three who admired the inventor as the "greatest man alive." He haunted the doorway in the hope of catching a glimpse of his idol as he entered or departed from his hotel.

"Come quick, Henry," shouted an employee who knew of the engineer's worship for the famous inventor. "Here comes Edison now!"

The engineer dashed to the street, just in time to see the top of Thomas Edison's head as the inventor went by surrounded by a crowd of admirers.

"Gosh," he cried, "I'd give my right arm to get to know that man!"

He got his wish unexpectedly that Summer. A convention of Edison lighting companies was called in August in the Oriental Hotel at Manhattan Beach, where cool ocean breezes tempered New York City's tropic Summer weather. At the dinner that marked the end of the convention, the head of the Detroit company, who happened to be sitting at the same table with Edison, leaned over toward the inventor.

"Mr. Edison, we've got a young engineer in Detroit who has invented a horseless carriage," he volunteered.

The inventor was immediately interested. He cupped a hand to his left ear and said: "That's mighty interesting. I think there's a great future for it. How does he make it run?"

"I don't know exactly, but he's here, just two tables away, and he could tell us."

"Call him over. I'd like to talk to him."

"Henry—Henry Ford! Come here a minute, will you."

The man sitting beside Edison rose and gave his chair to the flushed newcomer. Despite the difference of sixteen years in their ages, the great inventor took an immediate liking to the youthful engineer.

"Is your machine a four-cycle engine?" he asked kindly.

"Yes, sir, I've found that to be most economical and efficient. I'm working on a new spark plug now to explode the gasoline vapor in the cylinders."

"That's the thing, young man," he exclaimed. "You have it. Keep at it. Electric cars must keep near to power stations. Steam cars won't do either, for they must have a boiler and a fire. Your car is self-contained—carries its own power plant. No fire, no boiler, no smoke and no steam. You're on the right track. Keep on it!"

This was the beginning of one of the most famous friendships in history. When Henry Ford returned to Detroit he

told his patient wife exuberantly of his meeting with the renowned inventor.

"That bang on the table was worth worlds to me," he explained excitedly. "It's the first real encouragement I've ever had. The greatest inventive genius of the age says my gas motor is better than any electric motor could be—it could go long distances, he said, and there would be stations to supply the cars with hydrocarbon. That's the first time I ever heard that term for liquid fuel. You are not going to see very much of me until I am through with my car!"

Henry Ford and his inexpensive automobile were to usher in a new and brilliant age in transportation. Meanwhile, his new friend in West Orange with his wide-ranging genius that created a new industrial empire wherever he focussed his attention, was to make an important contribution of his own to that era with a compact, light-weight, powerful and long-lived storage battery.

It took ten years of unremitting effort to produce a storage battery that met Edison's specifications. Nature produces electricity in a storage battery because of interacting chemical changes in the elements contained in it. Edison decided to use an alkaline solution instead of acid in his battery. He supervised ten thousand experiments in a search for active elements that would combine with an alkaline base to produce an electric current. Each test ended in failure.

Don Harris walked into the laboratory late one night with a message from Mrs. Edison urging the inventor to come home for dinner. Noticing a broad smile on Edison's face, he blurted out excitedly, "You've found it, chief!"

"No, I haven't. Not yet. But I've finished the series and know several thousand things that won't work in the battery. Now I can start all over again tomorrow!"

Another time, a minor explosion destroyed most of the four

hundred open-mouthed tumblers in which the inventor was conducting his chemical tests. An exhausted associate hoped this would mark the end of the day's work.

"What'll we do next, Mr. Edison?" he asked.

"I guess the next thing to do will be to get another batch of tumblers and start all over again," was the cheerful reply.

During a court proceeding involving charges of infringement of an Edison patent, opposing counsel, who was seeking to prove that Edison was more of a discoverer than an inventor, grudgingly paid him a compliment on his indefatigable industry.

"If your Honor wished him to," he observed, "Mr. Edison could go into a field of grass a mile square and select therefrom the most perfect blade!"

When Edison had been working on the incandescent lamp, he had invented three thousand different theories in the development of electric light. Each theory appeared at the time to be reasonable and likely to be true. But only in two cases had exhaustive experiments upheld the theory. Now he hunted the proper combination of chemical elements for his storage battery with the same unflagging zeal and unbounded optimism.

"Remember," he would tell his associates who felt despondent over innumerable disappointments, "each failure brings us that much closer to ultimate success!"

Then one day, toward the end of the fifth year of his research, Edison obtained a promising clue. The galvanometer showed a sharp deflection in the presence of nickel hydrate. Using that as the positive element in his "electric wedding," he sought the negative end of the couple. He found what he needed in a special type of iron.

A special chemical plant was built to perfect the nickel-iron-alkaline storage battery. At the end of the ten-year quest

Edison had performed fifty thousand experiments and had spent \$3,000,000. But he had created a battery that gave a new impetus to transportation and industry.

Edison installed the new battery in half a dozen automobiles and trucks of various types and weights. He sent the machines over the worst possible roads, day after day, until they were wrecks. But the batteries stood the test admirably. The railroads welcomed the new battery for train lighting, air-conditioning and railway signalling. In mine haulage, in the operation of doors, lights and safety devices in subways, in rural areas where power stations were unavailable, in submarines, and wherever a long-lasting and absolutely dependable supply of power was required, the new Edison brain-child proved a tremendous boon.

While in the midst of his storage battery investigation, Edison had a visit from a distinguished foreigner. In the Spring of 1903 the Cunard liner *Lucania* docked in New York with Guglielmo Marconi aboard. Marconi had amazed the world two years earlier by transmitting the first stuttering messages across the Atlantic without wires. The new wireless system, however, was still a weak infant. Before it could grow into the giant it was destined to become, it needed a better detector than the magnetic one then in general use.

Marconi recalled a strange phenomenon discovered by Edison nearly two decades earlier. Edison had found that a mysterious current streamed from the heated filament of an electric bulb during his incandescent light studies. When he had put an independent wire or plate between the legs of the filaments of the lamp the plate had acted as a valve to control the flow of current. Immersed in his own researches, he had put the new discovery aside without doing anything more about it, not suspecting that he held the power to become the father of wireless and radio.

The advance in the theoretical knowledge of electronics since Edison's discovery led Marconi and his aides to realize that Edison had hit upon the solution to the problem of practical wireless telegraphy. So Marconi boarded the *Lucania* to visit West Orange, in the hope that the famous American would yield his patents on the mysterious electrical phenomena to him.

Marconi disembarked in New York in high spirits. He skillfully parried the eager questions of the newspaper reporters without revealing the nature of his mission and dashed to his hotel to hunt through railroad timetables. He arose early the next morning, which happened to be a Sunday, had a hurried, light breakfast and raced for his train.

Getting off at Orange, he walked quickly through the pleasant, quiet streets to the inventor's imposing residence. He rang the bell nervously. There was no answer to his ring. After a long interval, he rang again. He reproached himself for not having made more formal plans for his visit. Just as he was about to decide that no one was at home, the door suddenly opened. There stood the fifty-six year old inventor himself, dressed in old laboratory clothes.

"Come in, come in," he called out jovially, as he recognized his visitor. "I was in my den working on an experiment and could not get to the door sooner."

"I hope Mrs. Edison is well," the Italian inquired politely. The spacious house revealed no sign of its mistress—indeed, it seemed to be quite deserted except for Edison.

"Oh, Mrs. Edison is fine," was the genial reply. "She's going to be sorry she missed you. She's away on a visit to one of her sisters. She took all the children with her—they were so eager for the trip. So I told the servants to take a holiday, too. I'm alone in the house. Let's make ourselves comfortable. We'll have the whole day to ourselves to talk over things."

When Marconi broached his proposal for the Edison patents, he discovered to his joy that Edison had no objection to selling them. Edison was as pleased to help the youthful Italian inventor as he had been to encourage Henry Ford.

"I've been following your work and I think you deserve a lot of credit for standing up to all those scoffers," he said. "You cannot pioneer a new field of knowledge without seeing all the skeptics make fun of you, as you have learned. And when you succeed, they all want to jump in and rob you of the credit. Some other people have been after me for my patents. But I decided a long time ago that you could have them if you wanted them. They're yours."

The two inventors then plunged into a long and excited discussion of the possibilities of wireless telegraphy. The hours rapidly slipped away. Suddenly, Marconi felt faint with hunger. Stealing a glance at his watch, he noted that it was after two o'clock in the afternoon. No wonder he was starving! He decided to advance a gentle hint to his affable host.

"How do you manage about your meals when Mrs. Edison is away, Mr. Edison?" he suggested hopefully.

"Eh? Oh, I don't bother much about food, especially on Sundays. When Mrs. Edison is away, I let the servants go out—it makes the house quieter and I can work better. I can always manage with a sandwich or something."

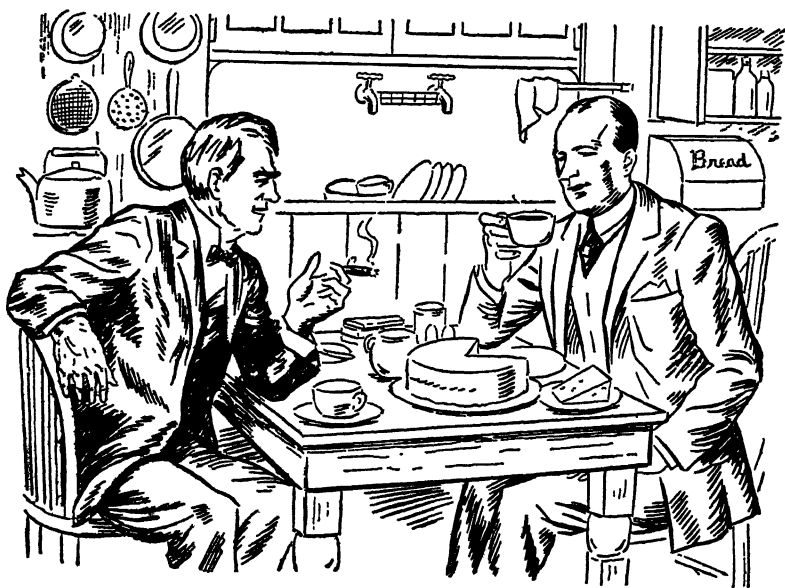
Marconi's heart sank. His host appeared to be in the mood for several hours' more of talk. And he had had nothing to eat since a very skimpy breakfast early that morning.

"Good gracious," Edison suddenly ejaculated, "how stupid of me. We've been talking away the hours and of course you haven't had any lunch. Wouldn't you like some nourishment?"

"Well, as a matter of fact, now that you mention it, I had only time for a brief breakfast, so perhaps . . ."

"Why, man, you must be starved. Come on. Let's see if we can find something in the kitchen and get something to eat!"

Marconi smilingly followed his host. After a brief reconnaissance, they found their way to the kitchen. Marconi made tea while Edison located some cheese and crackers and some fresh cake. Then the two sat down to their makeshift luncheon and continued to discuss the future of wireless for several more hours.



Wireless, radio, the automobile, the movies and the airplane—these were the great developments of the twentieth century. Edison's genius, which had touched and frequently transformed every conceivable aspect of human life, swept out its generous arms to endow with new meaning these contributions to the welfare of mankind. At the suggestion of James Gordon Bennett, he made researches before the Wrights on aeronautic principles. He designed the general

plan for a flying ship that somewhat resembled a "rocket ship." He constructed a helicopter in which guncotton, made from stock-ticker paper, was used as fuel.

"We've obtained good results," Edison reported to Bennett. "The solution to the problem of aerial navigation is only a matter of experiment. When an engine can be made that will weigh only three or four pounds to the horse power, the problem will be solved and flying will become a practical reality!"

The inventor also showed the nation how it could multiply its wealth in natural resources. He spent five years and \$3,000,000 of his money to do it, without, in the end, obtaining any practical repayment.

"But," he confessed, "I had a darn good time doing it!"

Vast industrial expansion had taught the country that steel production was one of its greatest needs but that its then available iron resources were limited. During a brief holiday to the seashore, Edison noted that the sand was mixed with black magnetic deposits. An idea immediately sprouted in his fertile mind. He built an extremely sensitive magnetic needle that dipped sharply toward the earth wherever the ground contained iron. Then he hired a group of young men to make a survey.

"Boys, I want you to start at the Canadian border and work over a strip twenty-five miles wide with the magnetic needle," he told them. "Go down as far as North Carolina. Then report back to me on your findings."

This survey revealed that a fabulous amount of low-grade iron ore lay in the ground literally everywhere. Edison purchased 16,000 acres of New Jersey land which his survey had shown to contain enough metal to supply the iron needs of the United States for the next century. Then he launched into what was even for him a new experience. He became a miner!

A mining town under the name of "Edison" sprang up on

the new property. The inventor devised gigantic magnetic separators to allow the extraction of the low-grade iron ore. Edison proposed literally to tear mountains apart. With a thunderous roar, giant boulders disappeared into the yawning bowels of his separators with their seventy-ton rollers. Boulders weighing six tons were crushed instantly into splinters. Pieces of rock weighing more than half a ton would be shot in the air twenty-five feet during the awe-inspiring operation. At the end of the process, the pulverized ore and rock, beaten to a consistency of fine sand, went streaming on conveyers past powerful magnets. These magnets pulled the iron ore in the stream to one side.

Edison spent much of his time at the mine. Since the machinery that he needed for his various complicated operations did not then exist, he invented them. One day he asked an engineer to make sketches for a special type of machinery for one of the operations. The next day the engineer submitted three.

"Hmmm!" Edison remarked, "I'm afraid none of these will do the work quite as well as we want to do it."

"That's too bad," the engineer replied. "There is no other way it can be done."

Edison said nothing. He returned two days later from his laboratory in West Orange with an armful of drawings.

"Here are forty-eight other ways of working out that operation we were talking about on Saturday," he said quietly.

Despite the pleas of his associates, Edison frequently risked injury and even death. While in the mine one day to investigate some difficulty, a landslide threatened to cut him off. Frantic workmen succeeded in digging out the unperturbed and still smiling inventor. On another occasion, a washer on one of the giant machines broke and sent a steel spring hurtling through the air.

"It came down just within an inch of my nose," Edison recalled, "and went clear through a two-inch plank. As they say, that was within an inch of your life!"

The discovery in the Mesaba Mountain ranges of Minnesota of huge deposits of rich iron ore which could be mined and transported to the steel mills in the East at low cost led Edison to call a meeting of his aides.

"Men, I don't think it's any use trying to compete with our new rivals," he said calmly. "But at least we've proved that there never need be a shortage of iron in this country. Now, I think we'll have to shut down this enterprise. However, the experience we have gained here can be useful to us in a new undertaking I have planned.

"My desire has always been to do everything in my power to further free the people of our country from drudgery and to create the largest possible measure of happiness and prosperity. I think we can help to do that by starting a cement factory that will produce a better cement than any we have now at a much lower cost. Before we get through, we shall be able to build six-room houses of cement for as little as \$300."

The inventor then retired to a drafting board. He got out a sheet of paper and began to draw. He worked steadily all that day and night. When he had finished he had created the plans, in every detail, for an enormous plant, half a mile long, that was expected to produce more than two million pounds of finished cement a day. Edison also designed and built a long rotary kiln such as never had been seen. The giant 150-foot long oven devoured fifteen tons of rock in one bite and produced 1,100 barrels of cement a day. Edison's new process for making low-cost cement provided a great new impetus to the building industry. It made possible the construction of huge stadia, including the Yankee Stadium in the Bronx in New York City, immense bridges, office buildings, factories

and inexpensive housing. Its success helped Edison to recoup the millions he had lost in his iron-ore concentration venture.

On June 28, 1914 an obscure town in Bosnia suddenly made screaming headlines in the world's newspapers. Its name was Serajevo. While visiting that place, the Archduke Francis Ferdinand of Austria was shot to death by a nineteen-year-old Serbian student. The assassination was the pretext for plunging Europe into the flames of war.

As a result of the conflict, there was an almost immediate shortage of chemicals in the United States. Most of these supplies had come from Germany. But Britain's naval blockade of Germany cut off this source. Among other things, German chemists excelled in the production of carboic acid from coal. The acid was an important ingredient in the manufacture of the newest improved Edison disk records.

"Mr. Edison, we have only a month's supply of carboic acid left," an alarmed associate informed the inventor. "We shall be forced to close down our phonograph plants if we can't overcome the shortage in some way."

"If the Germans can make carboic acid from coal, I don't see why we can't do it synthetically," the inventor rejoined briskly.

He called in a group of manufacturing chemists. They told him his solution for the problem was "impossible."

"Nonsense," cried the inventor. "Nothing is impossible. We merely don't know how to do it right now, but that does not mean we can't find out. All that is necessary to overcome a problem is to try. If you don't think you can do it, I will do it myself!"

Edison organized an "insomnia squad" of draftsmen, engineers and chemists and set them to work under his own supervision. Within a week, the squad, working on a twenty-four hour a day schedule, had prepared the plans for the first car-

bolic acid plant in this country. Another ten days and the plant for making the rare material had been erected and equipped. On the eighteenth day after he had been advised that it was impossible to produce synthetic carbolic acid Edison was doing the "impossible" at the rate of seven hundred pounds a day!

Next, Edison built a factory to make benzol and other coal-tar derivatives. Engineers had estimated a minimum of nine months to build the plant but Edison had his first coke oven in operation within forty-five days! Benzol was a basis of aniline oil, which in turn was important in the making of paraphenylenediamine and other dyes. Germany had also been the principal source of these dyes and the acute shortage following the outbreak of war threatened to ruin the fur and textile industries. Edison's answer to their frantic appeals for help not only relieved a serious emergency but his new processes created a new American industry. This country was permanently freed from dependence upon "secret formulaes" jealously guarded by its potential enemies.

Edison hated war. The work of science and invention, he felt, should be directed to promote the welfare and happiness of mankind and not to destroy one's fellow men.

"Making things which kill men is against my fiber," he asserted. "I would rather make people laugh."

When Germany sank the *Lusitania* in May, 1915, and launched an unrestricted submarine warfare against shipping, President Wilson and his Cabinet decided that the inventive, scientific and industrial power of the country should be mobilized to meet any crisis that might arise. Secretary of the Navy Daniels knew of Edison's hatred for war's carnage. But he wrote to the sixty-eight-year-old inventor in the hope that Edison could be induced to answer the country's urgent need.

"I have been intending for some time to write you express-

ing my admiration at the splendid and patriotic attitude you have taken in refusing to devote your great inventive genius to warlike subjects except at the call of your own country," Secretary Daniels said in his letter.

"There is a great service you can render the Navy and the country at large. One of the imperative needs is machinery and facilities for utilizing the natural inventive genius of Americans to meet the new conditions of warfare as shown abroad. It is my intention to establish a department of invention and development.

"I feel that our chances of getting the public interested and back of this project will be enormously increased if we can have, at the start, some man whose inventive genius is recognized by the whole world to assist us in consultation from time to time on matters of sufficient importance to bring to his attention. You are recognized by all of us as the man above all others who can turn dreams into realities and who has at his command, in addition to his wonderful mind, the finest facilities in the world for such work.

"This is a great deal to ask, and I unfortunately have nothing but the thanks of the Navy, and I think of the country at large, together with the feeling of service to your country that you will have, to offer you by way of recompense. I know the relief which the country would feel in these trying times at the announcement that you are aiding us in this all-important matter."

After careful consideration, Edison consented to head the Naval Consulting Board. He wrote Secretary Daniels that he would be glad "to give my whole time to the government without charge. Whatever I can do is at your command."

When the great "Preparedness Day Parade" was held on New York's Fifth Avenue on May 13, 1916, Edison marched at the head of the Naval Consulting Board's delegation. Secret

Service men were on each side of him, for the inventor had been threatened with death if he marched in the parade. Other threatening letters warned that the inventor's laboratories would be "blown up to heaven" if he persisted in his work for the government.

No harm came to Edison or to his workshops, but no mother was any happier than he when the human slaughter ended with the proclamation of the Armistice on November 11, 1918. The inventor received the Distinguished Service Medal for his war service, the only such award to a civilian by the Navy Department. In addition to his work as a consultant and an administrator, Edison created more than forty inventions that were in use when the war ended. The nature of these inventions was never completely revealed, because of the exigencies of military secrecy, but one of the inventor's major contributions was in plucking some of the thorns from the enemy's submarine menace.

He devised a sensitive apparatus that warned a ship of an approaching torpedo four thousand yards away and a method that enabled a ship to change its course quickly to a ninety-degree angle in order that the explosive might miss its intended target. He invented a system of camouflage for ships to deceive submarines, special repair mats to save ships that had been torpedoed, lights for ships that were visible to other vessels in a convoy but invisible to submarines. High-speed signalling devices for ships, gas masks, a direction finder for detecting hostile airplanes, a method for locating hidden enemy guns, extraction of nitrogen from the air and other chemical discoveries were on the long list of inventions that made his wartime contribution to his country one of the most notable and fruitful periods in the aging inventor's long life.

Chapter Fifteen

AMERICA'S UNCROWNED KING

“NEVER touched me!” Thomas Edison looked at the legend he had just scrawled upon the charred memento that had been rescued from the great fire. The flames had ruined six of the buildings of his great West Orange plant and had gutted the interior of seven other structures built of reinforced concrete. The scorched souvenir was a photograph of himself. Its frame was stained black with smoke and the glass was cracked. But the smiling, gentle likeness of the inventor had emerged from the \$5,000,000 conflagration unmarred. An aide who had found it in the ashes of one of the buildings had brought it to the inventor.

“Never touched me!” the inventor repeated softly, as he read aloud, half to himself and half to the group of anxious associates who surrounded him, the three courageous words he had written on the back of the photograph. “Well, lads,” he added cheerfully, brandishing the picture, “this is a good omen. It takes more than a big fire to get us down. Let’s go around and survey the damage. Tomorrow we shall start bigger and better buildings to replace the ones we’ve lost!”

The inventor’s aides had looked upon the fire and the loss of the uninsured buildings as a catastrophe. They marvelled at the calm, dauntless spirit in which he had received this stroke of ill fortune. But Edison felt that some bad luck was to be expected along with the good. Moreover, the fire gave him the sort of opportunity he loved above everything else—the opportunity to do things.

To buck up his downcast associates he quoted a favorite couplet from Longfellow:

“Into each life some rain must fall,
Some days must be dark and dreary.”

“You will notice,” he said, pointing with a note of triumph in his voice to the concrete structures, “these did not burn. The buildings we put up with our own cement not only cost less but are fireproof. I guess that proves we have the best cement-making plant in the world!”

The next day, Edison appeared with a sheaf of papers. They contained the plans for the new buildings. He had worked through a sleepless night preparing them. He took charge of a crew of fifteen hundred men who cleared away the debris of the fire and started the reconstruction. The foundations and walls of the new buildings began to rise almost before the ruins of the old were cold! A fortnight after the fire, the first of the new buildings was already in operation!

The zest, the almost joyous excitement with which Edison tackled the new problem that Fate had put in his lap continued to amaze, and awe, everyone who knew him. One of his admiring aides put the general sentiment in words when he remarked, “You would think he was a young man just starting on a career. Why, most men his age would have retired years ago!”

The question of his retirement from active life always evoked the inventor's amusement. As he grew older, it was put to him more and more frequently. He told the newspaper reporters who interviewed him on the eve of his seventy-fifth birthday in 1922 that he would retire “on the day before my funeral.”

“It's time enough to retire at one hundred,” he continued.

"I'm looking ahead. I've got enough ideas for new inventions to keep me busy for a hundred years more!"

He scorned the idea that he was getting old. For seventy-five years he had worked with little rest, with a passion for work that was like some other men's love for whiskey. He had ignored sleep and some of the other ordinary laws of Nature while working twenty hours or more at a time. But his mental agility and robust physical endurance was still remarkable at seventy-five.

"Look!" he ordered with a smile, boyishly eager to convince his interviewers that he still possessed his youthful vigor. He extended his right hand and touched it with the tip of his right foot, while he pirouetted on the toes of the other foot. "Growing old? I should say not!"

"Don't worry," Edison added, "but work hard, and you can look forward to a reasonably lengthy existence."

What was the secret of his genius?

"Genius," the inventor repeated scoffingly, "that's all bunk. There is no such thing. What some people choose to call my genius is simply hard work—ninety-eight per cent perspiration and two per cent inspiration. Ambition, imagination and a will to work—that does the trick!"

The famous inventor laughingly remarked that he applied his belief in hard work to his diet. "I don't eat squash," he explained to his surprised audience. "Anything that slips down as easily as that can't do you any good!"

Recreation? A change in work or environment was all the recreation one needed. Life could never be boring to anyone with an insatiable curiosity. It offered so many intriguing challenges to one's ingenuity! He quoted from a framed quotation that hung on the wall facing him: "There is no expedient to which a man will not resort to avoid the real labor of thinking."

"Unfortunately," he added, "thinking is the hardest work in the world for those who have not formed the habit of thinking. But it can also be the source of great pleasure and excitement."

Long before profit-drunk industrialists and others began to see the social and economic value of the shorter work week, Edison forecast "the universal five-day week." The world was to see a vast extension in the use of automatic machinery. And automatic machinery would mean less work and more of everything for all.

"The immediate result of the more extensive use of the automatic machine will not be a large unemployment but the increasing of the family income to such a point that the members who work will be amply able to provide those members who now work but who ought not to be at work," he asserted. "It will make it possible for a large family to be supported by the work of one member."

He ridiculed those who sought to block progress by maintaining "a dull, stupid resistance to change." Change was characteristic of life. People ought to take up a new idea quickly if it seemed good; but they ought to put it down again just as quickly if it proved to be bad. A machine age demanded a high level of intelligence. The fear that machines would make human beings into automatons was groundless. Machinery quickened intelligence. It presented mankind with a new tool with which to probe the secrets of the universe.

"Nature has many secrets—many surprises—left," said the man who had solved so many of Nature's mysteries. "Incidentally, it is great fun to dig into the unknown and pull something out of it!"

A world that had become accustomed to receiving surprises of all sorts from Edison got one of an entirely unanticipated nature when it learned that the inventor had invaded the field

of education. The idea was born during a discussion on one of the camping trips that the inventor had organized with Henry Ford, Harvey Firestone and John Burroughs, the naturalist, several years earlier.

This famous quartette spent a fortnight each Summer playing at being boys again. They would pick some picturesque area in the country—California, Nevada, the Adirondacks or a Southern mountain region—to tour. Sometimes other notables, including Luther Burbank and President Harding before his ill-timed death, would join the party.

One Summer, Edison and his companions, all in very high spirits, began their trip from Pittsburgh. Their motor caravan, including three passenger automobiles, three trucks and fourteen persons, traveled through West Virginia, Virginia and North Carolina, to Asheville. From Asheville, they motored back, covering a total distance of 2,300 miles.

Each night they slept under the canvas of their own tents. Thomas Edison had brought enough storage batteries to provide light and power. They were up about six-thirty each morning, washed at a nearby brook and ate a hearty breakfast. Henry Ford, the practical "handy man" of the group, would strip off his coat, get on his hands and knees and make the necessary repairs whenever anything went wrong with one of the machines. Edison's inventive talents came to the fore one cool night. He invented a new way of folding his blankets. He interlocked them in such a way that he was able to jump into them, as he said, "in one revolution."

The myriad wonders of nature that surrounded them appealed strongly to Edison and he loved to wander among the flowers and stones and to study the innumerable varieties of birds that made song overhead. At night, around the campfire, the other "vagabonds" listened intently as he gave his views on life and the great mystery of the universe.

He subscribed to no orthodox religious creed—"true religion consisted of doing good." Edison believed that the universe was alive, that there was "a central progressing core of life that went on and on." He did not care what a man's religious views were—"all I ask of a man is that he have honest convictions and principles and live by them."

"Formal education," he protested, "too often fails to develop a man's general intelligence. It does not encourage thinking. It paralyzes curiosity. It makes the important subjects so dull as to give the youngster the notion that everything important has to be dull. It has not kept pace with the general common sense of the people. One of the best illustrations of that is to be found in the discussion of nearly every public question."

Henry Ford and the others in the group around the blazing fire nodded in approval as the inventor dwelt on the importance of common sense rather than formal education in guiding a man's life.

"Why don't you do something, Tom, about encouraging that attitude in education?" Henry Ford asked.

"Well, as you know, when a man applies for a job in my plant I make him answer a lot of questions," the inventor replied. "Some people think those questions are silly. But they tell me whether a man has the right kind of character and mental development to be an executive in my employ."

"Why don't you expand the questionnaire and offer it to the youth of America?" the automobile magnate suggested. "You might give a prize to the lad who makes the best record!"

"That's a bully idea, Henry," the inventor cried. "I'll do it! I'll offer a college education free to the youth who wins the contest. But you must be one of the judges!"

Henry Ford agreed. Four other noted men were picked to serve on the jury. They were: Colonel Charles A. Lindbergh,

George Eastman, Dr. Samuel W. Stratton, president of the Massachusetts Institute of Technology, and Dr. Lewis Perry, headmaster of Phillips Exeter Academy.

The first contest was held in 1929. Young men in every corner of the country eagerly entered the competition. Forty-nine candidates representing each of the forty-eight States and the District of Columbia gathered in West Orange for the final test. There were four days of entertainment. Then the fun-making culminated in the final competition to pick the national champion.

There were fifty-seven questions in the quiz that Edison submitted to the tense students. The questionnaire was divided into four parts. The first three sections were devoted to physics, chemistry and mathematics.

"What is the difference between noise and musical sounds?" ran a typical physics question. "If a church organ is not provided with some sort of heating arrangement it will play out of tune when the church is cold. Why?"

Under the chemistry test, the students were asked to define the meaning of each of these terms: combining weight; density; atom; heat of reaction and valence.

Under the heading of mathematics, the questionnaire asked this puzzler: "A triangle, each of whose sides is six, is divided into three equal areas by drawing two lines parallel to the base. Where will these lines intersect the altitude?"

Intense public interest was aroused. The newspapers printed the Edison questionnaire in full for the benefit of their readers. Millions found amusement and instruction in trying their skill with the quiz. They felt cheered when even Professor Einstein confessed he was unable to solve some of the scientific problems without the aid of a textbook.

But the questions that created the greatest furore were

those that Edison asked the youthful competitors under the heading of General Intelligence. This part of the questionnaire was designed to test the general aptitude of the young men of the country and to determine their capacity for self-development and service to the community. Its aim was to disclose the "common sense"—whose development Edison regarded as the primary aim of education—possessed by the "quiz kids." Dinner tables throughout the world found cause for excited and sometimes heated debate in such questions as these:

"Which one of the following would you be willing to sacrifice for the sake of being successful? Happiness, comfort, reputation, pride, honor, health, money, love."

"If you were desirous of obtaining an order from a manufacturer with a jealous wife, and you saw him with a chorus girl, what would you do?"

"You are the head of an expedition which has come to grief in the desert. There is enough food and water to enable three people to get to the nearest outpost of civilization. The rest must perish. Your companions are: a brilliant scientist sixty years old; two half-breed guides, ages fifty-eight and thirty-two; the scientist's wife, interested mainly in society matters, age thirty-nine; her little son, age six; the girl you are engaged to marry; your best friend, a young man of your own age who has shown great promise in the field of science; yourself. Which would you choose to live and which to die? Give your reasons.

"If you were to inherit \$1,000,000 within the next year, what would you do with it?"

"When do you consider a lie permissible?"

"Give a brief statement of what you hope will be a typical day for you when you are fifty years of age."

"When you look back on your life from your deathbed, by what facts will you determine whether you have succeeded or failed?"

The sixteen-year-old son of a Protestant Episcopal Bishop in Seattle, Wash., won the contest with a score of 92 and elected to enter the Massachusetts Institute of Technology. Three other boys made such good showings that they also received four-year college scholarships at Edison's expense.

As Thomas Edison neared his eightieth birthday, he spent more and more time at Seminole Lodge, his Florida home at Fort Myers. A completely equipped laboratory, staffed with half a dozen aides, was near at hand. Mrs. Edison ordered hammocks strung all around the house and the spacious grounds. Whenever the aging inventor felt tired and wanted a bit of rest in the pleasant sunshine he could curl up in a hammock and snatch a little nap.

"My wife has cut down my working hours," he complained good-naturedly. He protested mildly that he was not allowed to work hard any longer—though his day began about eight-thirty in the morning and continued until midnight!

When Mrs. Edison, always the devoted wife and affectionate companion, reduced his daily allowance of cigars and coffee, the inventor accepted her gentle command with a smile. She cut out his favorite apple pie, when she discovered that it gave him indigestion. She made up a diet of simple foods that provided a maximum of nourishment with a minimum of strain on his digestive organs and such was her extraordinary sway over her famous husband that she had little trouble in persuading him to stick to it.

But while his body aged, the inventor's mind remained as keen and fresh as ever. He refused to look back. His notebooks were full of ideas that he meant to test in his laboratory. They would keep him busy for years and years!

"Why, we've just started on one of the greatest experiments of my life," he exclaimed with boyish enthusiasm. "As you know all the rubber that we need for our automobiles and trucks must come from Africa and Asia. Wouldn't the country be in an awful mess if we were dragged into war and our rubber supplies were shut off? I mean to find a way to grow our own rubber without relying on foreign sources!"



Thomas Edison's two good friends, Henry Ford and Harvey Firestone, had emphasized often during their camping trips that a sudden shortage of rubber might be "an irreparable calamity" to the nation. The two automobile magnates had acquired vast acreages in Brazil and Liberia to create rubber plantations there. Meanwhile, Henry Ford, who had purchased a Winter home next door to Seminole Lodge, encouraged Edison "to do something" about growing rubber in the United States.

The inventor experimented with fourteen thousand weeds, ferns, vines, shrubs and bushes of all kinds. The evergreen oleander shrub, with its leathery leaves, the ornamental, sweet-smelling honeysuckle and the sharp-pronged cacti from the desert all came under his scrutiny. He discovered that about 600 plants had some rubber content. He continued his selective process until he found that the most promising potential rubber plant was the native goldenrod with its crown of bright yellow flowers.

The luncheon-guests gathered at the Hotel Astor in New York City to celebrate Thomas Edison's eightieth birthday had their hopes dashed when they learned that the inventor would be unable to be present. They received instead a telegram from Fort Myers. It read:

"AM HAVING A FINE TIME ON MY PRESENT JOB."

W. H. Meadowcroft, the inventor's private secretary, told the disappointed guests that the inventor "with his accustomed thoroughness was ransacking the world for every bit of information he could obtain in regard to rubber and its cultivation and manufacture. The books he has thus far read would easily fill two five-foot bookshelves."

"Mr. Edison has undertaken a stupendous task," Meadowcroft added. "However, he glories in it, and has attacked the problem with his old-time completeness, vigor and enthusiasm. I have never seen him more thoroughly wrapped up in and concentrated on any of his investigations. Just now he is in the height of his work in Florida and for that reason could not leave to be with us today."

On the forty-ninth anniversary of the invention of the incandescent lamp a distinguished gathering assembled in West Orange to witness the presentation of the Congressional Gold Medal to Thomas Edison and heard President Coolidge

describe the eighty-one year old inventor as "the noble, kindly servant of the United States and benefactor of mankind."

A year later, on October 21, 1929, the whole nation and the world celebrated the fiftieth anniversary of the electric light, heaping honors on the aged inventor such as had never before been bestowed upon a private citizen. An expedition to the South Pole named a beacon erected in Antarctica in his honor. Newspaper editorials and college polls hailed him as "the greatest living American," the nation's most valuable single asset and the man whose brain had created industries that were worth \$15,599,000,000 and gave employment to 2,000,000 workers. The Post Office Department issued a special stamp portraying the first electric light lamp in honor of the anniversary.

Meanwhile, Henry Ford had recreated at Dearborn, Michigan, the historical buildings, the long tabernacle-like laboratory, the low brick machine shops, the original glass house and the carbon shed, that had stood at Menlo Park. They were equipped in the same manner as the original structures. Trees and even carloads of the red-tinged New Jersey clay were moved from Menlo Park to the new location.

This shrine was dedicated to the American people as a part of the fiftieth anniversary celebration. Thomas Edison and Mrs. Edison traveled to it with President and Mrs. Hoover.

"Well, Tom, what do you think of it?" His friend Henry Ford asked him affectionately as they toured the reconstructed Menlo Park.

The inventor stared, chuckled and trembled a bit as he looked about, too deeply moved for a moment to speak. His white hair waved gently in the October breeze, for even at eighty-two he refused to wear a hat. Then a twinkle rose to his clear gray-blue eyes as he observed, "Henry, except for one thing, it's perfect!"

"What is the one thing that is wrong?" Henry Ford asked anxiously.

"Our floor was never as clean as you have it here!" Edison laughed. "Aside from that, it's an amazing reproduction. I wouldn't have believed it possible!"

Mrs. Edison tried to button her husband's coat as the little group strolled through the reconstructed Menlo Park. He pulled away like a boy who refused to be coddled by his mother who wanted him to wear a muffler.

"I'm all right," he protested. "I can take care of myself. I'm just as young as I was when I worked there in the old laboratory." He nodded toward the old tabernacle-like building, with the stump of an old elm tree in front of it.

His wife sighed and let him have his own way.

The dinner that was held that night found the most famous men and women in the United States gathered to pay homage to the noted inventor. Tributes and messages of greeting arrived from abroad from kings, presidents and leaders of science. The radio broadcast the thrilling event as Thomas Edison, aided by Francis Jehl, reenacted the birth of the electric light. The countless candles that had been burning in the hall and in countless homes were suddenly snuffed out and electric lights blazed forth in all their radiance to recall, once again, the revolution that had taken place in the world with the shift to "electric sunshine." In New York City, Broadway was transformed into a "golden way" with special gold lights and other cities marked the jubilee celebration with spectacular lighting effects against the star-studded sky.

The distinguished gathering at the dinner broke into cheers when President Hoover rose to praise Thomas Edison as one of America's "most priceless national possessions" who had "by his own genius and effort risen from a modest beginning to membership among the leaders of men."

When that storm of applause had died down, the audience looked expectantly to the white-thatched inventor. Thomas Edison had lived through the most strenuous day of his life. Old memories and one round of excitement after another had robbed him of his usually calm and serene composure. He stood stilent for a moment—an old man upon whom the exciting recollections of eighty-two years were flooding back. His audience, too, was almost breathlessly quiet, awed by the drama before their eyes.

Then the octogenarian inventor lifted his head with a tremulous smile. He made an obvious effort to regain control of his emotions. But there was an unmistakable quiver in his voice as he spoke.

"This experience makes me realize as never before that Americans are very sentimental," he said. "I am filled with gratitude. I thank our President and you all. As to Henry Ford, words are inadequate to express my feelings. I can only say to you that, in the fullest and richest meaning of the term—he is my friend. Thank you and good night."

The hall rocked with cheers as the inventor sat down quickly. However, Mrs. Edison, sitting beside him, noticed immediately that the inventor had slumped a little in his chair. He had grown suddenly very pale. She anxiously summoned President Hoover's private physician nearby. At first, the inventor refused to leave. But the two quietly persuaded him to retire to a sofa in the small room back of the speaker's table. An injection of adrenalin brought the color back to his cheeks. After a little rest the inventor appeared to be his normal self again.

At the insistence of Mrs. Edison and Henry Ford, the inventor reluctantly agreed to rest at the Ford home for a few days. He submitted to a thorough medical examination. This revealed that he was suffering from a combination of ailments,

including uremic poisoning, diabetes and gastric ulcers. His remarkable, iron-like constitution which for eighty-two years, had labored incessantly under his indomitable drive, regardless of the ordinary laws of Nature, was at last wearing down. He had to go on a milk diet.

But his unconquerable spirit remained undimmed. Back in Fort Myers, he succeeded in cross-breeding goldenrod plants until he could produce varieties that were more than twelve feet tall and rich in rubber content.

"Give me five years more and the United States will no longer be dependent on any foreign source for its rubber," he predicted exuberantly. "We shall have a rubber crop of our own that will meet all our needs, in peace or in time of war. We can now raise one hundred pounds of rubber to an acre of goldenrod. Within a few years, I expect to raise this to one hundred and fifty pounds. There are tremendous possibilities ahead!"

At eighty-two, the aged inventor was still looking forward, not back! His father and grandfather had lived to be more than ninety and he expected to outlive them both!

When impurities that appeared in the rubber extracted from his goldenrod created difficulties, he developed new machinery and new chemical processes to obtain a purer product. He succeeded in obtaining his first piece of vulcanized rubber from goldenrod. But that was to be his last great achievement.

On August 1, 1931, the alarming news flashed throughout the world that Thomas Edison suddenly had collapsed while working in his laboratory in West Orange. He was reported on the verge of death. The inventor, now eighty-four years and six months old, was not expected to survive. But the dauntless spirit who had defied poverty, failure, ravaging fires and other

misfortunes, now amazed his attending physicians by rising from what had been expected to be his deathbed.

Though he wished to return to his laboratory, he was too weak to do so. He was ordered to take a complete rest. He obeyed those orders because he hoped to regain sufficient strength to resume his work. He took daily automobile rides with Mrs. Edison through the picturesque countryside. She



who had been his devoted wife for nearly a half century was now his constant companion. When the invalid, unaccustomed to inactivity, fretted at the ministrings of his physicians or the white-capped nurses, Mrs. Edison touched his forehead softly or whispered gently to him. Immediately, he would regain his good nature and become the amenable patient again.

But as the blistering heat of Summer gave way to the cool

winds and the changing colors of Autumn, Thomas Edison gradually grew weaker. His once immense vitality ebbed. It became apparent that his surprising battle against the angel of death could have but one ending. By October 15 the spark of life had become so faint that he sank into a coma. He lingered for three days more as a mourning world awaited the word that the gallant spirit who had embarked on so many great adventures had gone on the greatest adventure of all. His once tireless heart faltered—then stopped at twenty-four minutes after three o'clock Sunday morning, October 18, 1931.

On the fifty-second anniversary of the birth of the electric light, as twilight fell on Wednesday, October 21, Thomas Alva Edison was put to his final resting place beneath a great oak tree on a knoll in Rosedale Cemetery near Glenmont. Mrs. Edison, maintaining the extraordinary fortitude she had shown all during the inventor's last days, did not falter. She leaned over to kiss the casket that contained her husband's body as it was about to be lowered into its grave and then stepped back to toss a white rosebud upon it as it sank from view. She could see in the distance, far off above New York City, the increasingly intense sky-glow from the lights the inventor's genius had given the world. As she turned away to return to Glenmont, without the affectionate companion who had been at her side since she had been a girl of twenty, she fortified herself with snatches from the poem that had been written to commemorate his passing:

“They do not die, those dauntless ones who go
 Into the silence of that narrow room:
Great spirits are not conquered by the tomb;
They are immortals.

So has one passed the day
From life's full years of service.
He is not dead—Such men can never die!”

That night, at ten o'clock, on land and sea, in bustling cities and in sleepy hamlets, in a simultaneous national tribute proclaimed by President Hoover, millions turned out their lights to plunge the country into momentary darkness. It was the final homage the nation could pay to the man who had made the night brighter for all humanity and whose life had transformed and enriched civilization in every corner of the globe.

But Thomas Edison would have been surprised by that vast outpouring of sorrow. He had always accepted the mysteries of life and Nature as a challenge. Death was merely the greatest mystery and therefore the greatest challenge of all. He believed in meeting such challenges cheerfully and hopefully, searching them for an opportunity for his great, restless, surging spirit to achieve some glorious new conquest. •

Highlights in the life of
THOMAS ALVA EDISON

1847-1931

- 1847 the future inventor was born on February 11 at Milan, Ohio, the son of Samuel and Nancy Elliott Edison.
- 1854 when young Tom Edison was a boy of seven, the Edison family moved to Fort Gratiot on the northern outskirts of Port Huron, Michigan.
- 1859 now a twelve-year-old boy, Tom Edison became a newsboy and "candy butcher" on the new railroad operated by the Grand Trunk Railway between Port Huron and Detroit. He printed a newspaper, "The Weekly Herald," and established a chemical laboratory in the baggage car of the train.
- 1864 giving up his railroad career, he became a telegraph operator through the assistance of J. U. MacKenzie, the station agent at Mount Clemens, whose son he had saved from the path of a runaway train.
- 1868 after four years of vagabonding as a telegraph operator in various cities throughout the Middle West, he arrived in Boston and began working in the Western Union office in that city. On October 11 of the same year, he obtained a patent for his first invention—an electrical vote recorder.
- 1869 landed in New York City from the Boston boat, penniless, and had his first breakfast in the big city—a cup of tea given him by a kindly merchant. Began working for the Gold Indicator Company.
- 1870 sold his improved stock ticker for \$40,000, the first money he received from an invention, and opened a shop in Newark, where, as "a bloated Eastern manufacturer," he manufactured stock tickers and other electrical instruments.
- 1871 his mother, Nancy Elliott Edison, died on April 9. On Christmas Day of the same year, he married Mary Stillwell.
- 1872 expanding his factories in Newark, he turned out many improvements of telegraph instruments during the years that followed, including the duplex and quadruplex telegraphs.

- 1875 discovered a previously unknown electrical phenomenon which he named "etheric force" and some people referred to as "the Edison effect." Many years later, this discovery proved the basis of wireless and radio.
- 1876 the first laboratory for organized research was established by the inventor at Menlo Park.
- 1877 invented the microphone and the carbon telephone transmitter. Obtained a patent in the fall of the same year for the first phonograph.
- 1878 invented the microtasimeter and tested that device to measure heat radiated by the sun's corona at a total eclipse of the sun in Wyoming.
- 1879 on October 21 was born the first practical incandescent lamp when the inventor succeeded in keeping a lamp alight for more than forty hours.
- 1880 developed new dynamos and other electrical apparatus for generating and distributing electric light and power. Invented the magnetic ore separator and operated the first passenger electric railway in this country at Menlo Park.
- 1881 opened offices at 65 Fifth Avenue in New York City for the Edison Electric Light Company and opened several factories in New York City for making electrical apparatus.
- 1882 established the first commercial central power station at 257 Pearl Street in New York City.
- 1884 his wife, the former Mary Stillwell, died, leaving him with three children to care for—Marion, Thomas, Jr., and William.
- 1885 developed wireless induction telegraphy.
- 1886 married Mina Miller, daughter of Lewis Miller, an inventor of agricultural machinery, of Akron, Ohio. Bought Glenmont, a palatial estate in Llewellyn Park, West Orange, New Jersey, for his bride.
- 1887 shortly after moving the Edison Machine Works to Schenectady, where it became the nucleus of the General Electric Company, the inventor moved his laboratory to West Orange.
- 1890 a son, his first by his second marriage, was born. He was named Charles and was succeeded by two other children—a daughter, Madeleine, and a second son, Theodore. The inventor's three children by his second marriage made him the father of six children in all—four sons and two daughters.

- 1891 obtained a patent on the motion-picture camera. First commercial showing of motion pictures took place at Koster and Bial's Music Hall, with the aid of the Edison Vitascope, on the night of April 23, 1896.
- 1892 for several years worked on the iron-ore concentration system while conducting experiments, at the same time, in a large variety of other fields, including electric power, the phonograph and the X-ray.
- 1896 Samuel Edison, the inventor's father, died.
- 1900 began his work on the storage battery, which was to culminate ten years later in the invention of the Edison nickel-iron-alkaline storage battery.
- 1901 began construction of the Edison cement plant and development of long rotary kilns for cement production.
- 1914 with the outbreak of war in Europe, Edison concentrated his energies on inventing substitutes for drugs, dyes and other materials previously obtained from Germany. He developed a new process for making synthetic carboric acid, coal-tar products necessary for the manufacture of explosives and many safety devices.
- 1915 was named president of the Naval Consulting Board, which was organized by the President of the United States to plan for the national defense.
- 1928 received the Congressional Medal of Honor.
- 1929 on October 21 the fiftieth anniversary of the birth of the electric light was commemorated throughout the country and at Dearborn, Michigan, where Edison's good friend, Henry Ford, had re-created a replica of the Menlo Park laboratory.
- 1930 despite his advanced years, pursued extensive research, on his winter estate in Florida, on growing goldenrod for the purpose of creating a source of native rubber for the United States. Succeeded in vulcanizing the first piece of rubber from goldenrod he had grown.
- 1931 died on October 18 at Glenmont at the age of 84.

A SELECTED BIBLIOGRAPHY

- THE BOY'S LIFE OF EDISON by W. H. Meadowcroft. Harper & Bros
- THOMAS A. EDISON by F. T. Miller. John C. Winston & Co.
- EDISON, THE MAN AND HIS WORK by George S. Bryan. Alfred A. Knopf, Inc.
- THE LIFE AND INVENTIONS OF THOMAS ALVA EDISON by W. K. L. Dickson. Chatto & Winders
- EDISON, HIS LIFE AND INVENTIONS by Frank L. Dyer. Harper & Bros.
- THOMAS A. EDISON, THE YOUTH AND HIS TIMES by W. A. Wise. Rand, McNally & Co.
- THOMAS ALVA EDISON by Francis Robert Wheeler. Macmillan
- A BOY WITH EDISON by William A. Simonds. Doubleday, Doran & Co.
- EDISON, HIS LIFE, HIS WORK, HIS GENIUS by William Adams Simonds. Bobbs-Merrill Co.
- EDISON, MODERN OLYMPIAN by Mary Childs Nerney. Smith & Haas
- EDISON AS I KNEW HIM by Henry Ford, in collaboration with Samuel Crowthers. Cosmopolitan
- THOMAS ALVA EDISON by Francis A. Jones. Thomas Y. Crowell Co.
- RECOLLECTIONS OF EDISON by Dr. David Trumbull Marshall. Christopher Publishing House
- EDISON AND HIS INVENTIONS by J. B. McClure. Rhoades & McClure
- HISTORY OF THE ELECTRIC LIGHT by Henry Schroeder. The Smithsonian Institution
- LIGHT AND ELECTRICITY by John Tyndall. D. Appleton & Co.
- A POPULAR HISTORY OF AMERICAN INVENTIONS by Waldemar Kaempfert. Scribner.
- MEN AND VOLTS by John W. Hammond. J. B. Lippincott Company

INDEX

- Adams, Milton, 36, 37, 39
 Alarm clock device, 31
 Arc light, 99
- Barker, George F., 95
 Barometer, 97
 Batchelor, Charles, 109, 122, 125, 126, 185
 Beethoven music, 165
 Bell, Alexander Graham, 69, 70, 71
 Bennett, James Gordon, 129, 141, 198
 Black Maria movie studio, 188
 Boston, 37, 130
 Bradley, Alva, 9
 Brush and arc light, 99
 Buddhists, 92
 Burbank, Luther, 210
 Burroughs, John, 210
- California, 142
 Canadian rebellion, 5, 9
 Central Park, 152
 Columbia, 129, 142
 Connery, Thomas B., 111, 129, 141
 Consolidated Edison Company, 126, 136
 Coolidge, Calvin, 216
 Corbett, James J., 188
- Daguerre, 186
 Daniels, Josephus, 203
 Davy, Sir Humphry, 99
 Deafness of Edison, 28
 Dearborn, 217
 Detroit, 3, 17, 22, 191
 Dumas, Alexandre, 166
- Ear trumpet, 97
 Eastman, George, 186
 Eclipse of sun, 96
 Edison, Charles, 173
 Edison, Madeleine, 173
 Edison, Marion, 63, 88, 149, 169
- Edison, Mary Stillwell, 59, 61, 89, 93, 131, 149, 164
 Edison, Mina Miller, 160, 162, 163, 165, 169, 217, 221
 Edison, Nancy Elliott, 9, 14, 52, 61
 Edison, Samuel, 8, 10, 52, 64, 191
 Edison, Theodore, 173
 Edison, Thomas Alva
 birth of, 9
 birthday interview with, 207
 childhood of, 1, 9
 education of, 14, 16
 employed as telegrapher, 29, 39
 first laboratory, 11, 12, 23
 first lecture, 41
 greatest American, 217
 ideas on education, 211
 intelligence test, 212
 last days of, 222
 newspaper publisher, 22
 rescues child from train, 29
 services during war, 203, 205
 views on religion, 211
 Edison, Thomas Alva, Jr., 63, 149
 Edison, William L., 63, 149
 Edison Electric Light Company, 107, 130
 Edison General Electric Company, 157
 Edison Electric Illuminating Company, 135
 Edison Lamp Company, 124
 Edison Machine Works, 126
 Edison meter, 138
 Edison Portland Cement Company, 201
 Edison star, 120
 Edison Telephone Company, 74
 Eiffel Tower, 169
 Electric cigar lighter, 141
 Electric light, 100, 108-121
 Electric pen, 67
 Electric power, 142, 146
 Electric railway, 143, 146

- Electronics, 196
 Etheric force, 68
 Exposition Universelle, 168

 Faraday, Michael, 39
 Firestone, Harvey, 210
 Florida, 163, 191
 Ford, Henry, 192, 210, 217
 Fort Gratiot, 8
 Fort Myers, 163, 191, 214
 Fox, Marshall, 111, 140
 Franklin, Benjamin, 169

 Galvanometer, 98
 General Electric Company, 126, 157
 Germany, 202
 Gilliland, Ezra T., 160
 Gladstone, 90
 Glenmont, 163, 173
 God, Edison's views on, 211
 Gold Indicator Company, 47
 Gold and Stock Telegraph Company,
 49
 Goldenrod experiments, 215
 Gould, Jay, 97
 Grant, General U. S., 19
 Gray, Elisha, 69
 Green, Dr. Norvin, 55

 Harding, President, 210
 Hayes, President, 86
 Hello, first use of, 75
 Holmes, Oliver Wendell, 148
 Hoover, President Herbert, 217
 Horse cars, 143
 Humbert, King, 171
 Hygrometer, 97

 Indianapolis, 36
 Insomnia squad, 121
 Insull, Samuel, 74, 126
 Iolanthe, 131
 Iron ore tests, 200
 Italy, 171

 Jablochhoff, 100
 Japan, 122
 Jeannette, 129
 Jehl, Francis, 104, 217

 Kruesi, John, 77, 126, 137, 146, 155

 Lake Chautauqua, 161
 Laboratories of Edison, 11, 12, 23, 51,
 66, 126, 179
 Lefferts, General Marshall, 49
 Lenawee Junction, 35
 Lincoln, 34
 Lindbergh, Colonel Charles, 211
 Llewellyn Park, 163
 London, 74, 171
 Longfellow, 207
 Louisville, 34
 Lowrey, Grosvenor P., 144
 Lusitania, 203

 Mackenzie, Jim, 29
 Macy, R. H., 190
 Marconi, Guglielmo, 195
 Memphis, 34
 Menlo Park, 66, 85, 90, 114, 121, 132,
 142, 149
 Mexico, 37
 Milan, 9
 Miller, Lewis, 87, 160
 Milliken, G. F., 37
 Minnesota, 201
 Morgan, J. Pierpont, 107, 140
 Morse, Hiram, 31, 53, 62
 Motion pictures, 188
 Motion Picture Patents Corporation,
 190
 Mount Clemens, 29

 Nashville, 34
 Naval Consulting Board, 204
 Newark, 51, 65
 Newsboy, 6, 20
 New Baltimore, 3, 6
 New Orleans, 33
 New Siberia Island, 129
 New York, 45, 51, 125, 190
 New York Central, 148
 New York Herald, 111, 129, 140, 147
 Niblo's Garden, 130
 Nick, 176
 Northern Pacific, 129, 142

 Odoroscope, 97
 Orr, Albert, 111
 Orton, William, 71

 Paraffin paper, 60

- Paris, 168
Paris Centennial Exposition, 168
Patent office, 183
Pearl Street station, 126, 132
Philadelphia, 66
Phonograph, 77, 84, 87
Phonomotor, 96
Port Huron, 3, 9, 51
Porter, Charles, 139
Portland cement, 201
- Radio, 68
Reis, Philip, 68
Ridgeway, 4
- Schenectady, 156
Scholarship awards, 212
Scientific American, 84
Shiloh, Battle of, 20
Smith's Creek, 28
South America, 36
Staten Island, 160
Stevenson, Alexander, 26
Stillwell, Alice, 58, 62, 149
Stillwell, Grandmother, 150
Storage battery, 194
Storey, Wilbur F., 21
Stratford Junction, 29
Sullivan, John L., 188
- Tasimeter, 98
Telegraph, 54
- Telephone, 68
Third rail, 146
Thomson-Houston Company, 157
Torpedo, 205
Typewriter, 57
- Union Pacific, 97
Universal printer, 49
Upton, Francis R., 127
- Vacuum tube, 105
Vera Cruz, 37
Vienna, 4
Villard, Henry, 129, 142, 146
Vincent, John H., 86
Vitascope, 190
Vote recorder, 42, 43
- Wallace, William, 99
War inventions, 205
Washington, D. C., 85
Wealth created, 217
Western Union, 34, 37, 39, 55, 71, 97
Westinghouse, George, 153, 158
West Orange, 179, 206
Wheel of Life, 186
Wilson, Woodrow, 203
Wireless telegraphy, 68, 195
Wright, Orville, 198
Wyoming, 95
- Yankee Stadium, 201

